Study
Report
2005-02

A Model of Reenlistment Behavior: Estimates of the Effects of Army's Selective Reenlistment Bonus on Retention by Occupation

Paul F. Hogan
Javier Espinosa
Lewin Group, Inc.

Patrick C. Mackin
SAG Corporation

Peter M. Greenston
U.S. Army Research Institute

United States Army Research Institute
for the Behavioral and Social Sciences

JUNE 2005

U.S. Army Research Institute
for The Behavioral and Social Sciences

A Directorate of the Department of the Army
Deputy Chief of Staff, G1

ZITA M. SIMUTIS
Director

Research accomplished under contract
for the Department of the Army

Human Resources Research Organization
Lewin Group, Inc.
SAG Corporation

Technical review by

Michael L. Hansen, Center for Naval Analyses
John H. Enns, OSD, Personnel and Readiness

NOTICES

DISTRIBUTION: Primary distribution of this Study Report has been made by ARI. Please address correspondence concerning distribution of reports to: U.S. Army Research Institute for the Behavioral and Social Sciences, Attn: DAPE-ARI-MS 2511 Jefferson Davis Highway, VA 22202-3926.

FINAL DISPOSITION: This Study Report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this Study Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
June 2005	Final	November 2000 – December 2004

4. TITLE AND SUBTITLE

A Model of Reenlistment Behavior: Estimates of the Effects of Army's Selective Reenlistment Bonus on Retention by Occupation

5a. CONTRACT OR GRANT NUMBER
DASW01-98-D-0047 (D.O. 0027; 0044)

5b. PROGRAM ELEMENT NUMBER
665803

6. AUTHOR(S)

Hogan, Paul F. (Lewin), Espinosa, Javier (Lewin), Mackin, Patrick C. (SAG) and Greenston, Peter M. (ARI)

5c. PROJECT NUMBER
D730

5d. TASK NUMBER
265; 290

5e. WORK UNIT NUMBER
C01

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Lewin Group, Inc.	SAG Corporation	Human Resources Research Org.
Suite 500	Suite 200	Suite 400
9302 Lee Highway	4115 Annandale Rd.	66 Canal Center Plaza
Fairfax, VA	Annandale, VA	Alexandria, VA
22031	22203	22314

8. PERFORMING ORGANIZATION REPORT NUMBER
FR-02-34 (HumRRO)

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S. Army Research Institute for the Behavioral & Social Sciences
2511 Jefferson Davis Highway
Arlington, VA 22202-3926

10. MONITOR ACRONYM
ARI

11. MONITOR REPORT NUMBER
Study Report 2005-02

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Contracting Officer's Representative and Subject Matter POC: Peter Greenston.

14. ABSTRACT *(Maximum 200 words)*:

A logit model was applied to estimate the effect of selective reenlistment bonuses (SRBs) on the retention rates of Army Soldiers. The model was estimated separately by occupational group and by first (zone A), second (zone B) and third term (zone C) reenlistment decisions. An "annualized cost of leaving" (ACOL) variable was constructed to estimate the net financial returns to reenlisting in the Army compared to leaving for the civilian sector. The model was estimated using data on actual reenlistments from the period FY1990 through FY2000.

The effects of SRBs on reenlistments at Zones A, B, and C were estimated at three levels of occupational aggregation—all Army, CMF, and MOS. After out-of-sample testing, we re-specified and re-estimated the model. In general, the results for Zone A at all levels of occupational aggregation indicate that reenlistment bonuses have a positive and statistically significant effect on Zone A reenlistments. The magnitude of the effect varied by occupation, but a one-level increase in SRB at Zone A typically increases the reenlistment rate by three to seven percentage points, depending upon the occupation. The results for Zone B are also solid at both the CMF and MOS levels. Results for Zone C, where reenlistment rates are typically very high, were reasonably solid but not as good as the Zone A and B results. We were unable to obtain positive, statistically significant ACOL parameter estimates for a small number of occupation groups. Statistically significant effects for demographic control variables and labor market conditions were also obtained.

15. SUBJECT TERMS

Personnel, Retention, Compensation

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	61	Ellen Kinzer Technical Publications Specialist (703) 602-8047

Standard Form 298

Study Report 2005-02

A Model of Reenlistment Behavior: Estimates of the Effects of Army's Selective Reenlistment Bonus on Retention by Occupation

Paul F. Hogan
Javier Espinosa
Lewin Group, Inc.

Patrick C. Mackin
SAG Corporation

Peter M. Greenston
U.S. Army Research Institute

Selection and Assignment Research Unit
Michael G. Rumsey, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
2511 Jefferson Davis Highway, Arlington, Virginia 22202-3926

June 2005

Army Project Number	**Personnel and Training**
665803D730	**Analysis Activities**

FOREWORD

The Selective Reenlistment Bonus (SRB) program – with an annual budget of about $100 million – helps the Army meet reenlistment goals in approximately 200 military occupations. The U.S. Army Research Institute for the Behavioral and Social Sciences has conducted original empirical research into the impact of the SRB program on reenlistment behavior.

The retention research reported here is designed to assist the Army in the efficient management of the SRB program. In the first phase of the study, retention parameters that capture the financial incentive effects of the SRB reenlistment program were estimated for Army occupations using data over the FY1990 to FY2000 period. In the second phase, these parameters were embedded in a web-based SRB Management System to provide the program analyst with estimated impacts upon retention and corresponding costs (at the Army occupation level) of alternative SRB plans. The analysis model is ready to assist with FY2005 plans and can be updated for FY2006 (and beyond). The SRB Management System is described in an accompanying ARI report.

These research results and the application analysis model have been briefed to the staffs of the Director of Military Personnel Management, Army G-1, and Retention Management Branch, Enlisted Personnel Management Directorate, Army Human Resources Command.

MICHELLE SAMS
Technical Director

A MODEL OF REENLISTMENT BEHAVIOR: ESTIMATES OF THE EFFECTS OF ARMY'S SELECTIVE REENLISTMENT BONUS ON RETENTION BY OCCUPATION

EXECUTIVE SUMMARY

Research Requirement:

The Selective Reenlistment Bonus (SRB) program is the primary way the Army can provide reenlistment incentives that can vary by occupational specialty. Under the SRB program, the Army sets a SRB award level (ranging from zero to eight) by military occupational specialty (MOS) for Soldiers at Zone A (between 17 months and 6 years of active service), Zone B (between 6 and 10 years of active service), and Zone C (between 10 and 14 years of active service). The Soldier is then offered a cash bonus equal to the product of the award level, the member's monthly basic pay, and the number of years (between 3 and 6) that the member chooses to reenlist. Soldiers may receive only one SRB award while in a given zone. Until recently, the policy was to pay half of the bonus at the time of reenlistment while the remaining half was paid to the Soldier in equal installments on the anniversary of the reenlistment, over the Soldier's term of reenlistment. The policy changed in August 2004, and the Army may now specify that reenlisting Soldiers in some specialties are eligible to receive the entire bonus at the time of reenlistment.

Efficient allocation of reenlistment bonuses requires the ability to estimate the effect that the bonus will have on reenlistments in an occupational specialty. The purpose of the research reported in this paper is to provide estimates of the effect of reenlistment bonuses, at each reenlistment zone, across occupations.

Procedure:

In the analysis of the effect of selective reenlistment bonuses on Army enlisted retention, we modeled the decision as a rational choice by the Soldier to remain in the Army or to leave, based on the benefits and costs associated with the alternatives. We applied the Annualized Cost of Leaving Model (ACOL) to estimate the financial incentive to stay. This model estimates the financial incentive to stay as the difference in annualized military and civilian pay, computed from the decision point to an optimal time horizon. The SRB was included in the ACOL computation. The econometric model was estimated as a logistic regression.

The Army provided data on reenlistment decisions made in FY1990 through FY2000. We received annual extracts of the Enlisted Master File (EMF) for September 1989 through September 2000 and extracts of the Enlisted Loss File for the 11 fiscal years in the study. We used these data to identify Soldiers eligible to make stay/leave decisions, characterize their decisions, and generate explanatory variables for the estimation. We generated individual records for each reenlistment decision observed in the analysis period.

Findings:

We estimated the effects of SRBs on reenlistments, at Zones A, B, and C at three levels of occupational aggregation—all-Army, career management field (CMF), and MOS. After out-of-sample testing, we re-specified and re-estimated the model. In general, the results for Zone A at all levels of occupational aggregation indicate that reenlistment bonuses have a positive and statistically significant effect on Zone A reenlistments. The magnitude of the effect varied by occupation, but a one-level increase in SRB at Zone A typically increases the reenlistment rate by three to seven percentage points, depending upon the occupation. The results for Zone B are also solid at both the CMF and MOS levels. Results for Zone C, where reenlistment rates are typically very high, were reasonably solid but not as good as the Zone A and B results. We were unable to obtain positive, statistically significant ACOL parameter estimates for a small number of occupation groups. The reason is probably the lack of variation in bonuses. Nevertheless, we provided estimates for all three zones for all MOS. In the case of Zone C, however, we sometimes relied on higher-level occupational aggregations to obtain estimates.

Utilization of Findings:

These econometric results have been incorporated into a web-based Army SRB Management System (described in another ARI report). This system allows the user to predict the number of reenlistments, as a function of the award level offered. It does this at the MOS level, by zone. We used the empirical relationship between the reenlistment rate and the SRB award level established in this research to project the effects. The user can modify the SRB plan and alter a number of policy variables – including military and civilian pay raises, the long-term inflation rate and other factors – when predicting reenlistments and evaluating alternative plans.

A MODEL OF REENLISTMENT BEHAVIOR: ESTIMATES OF THE EFFECTS OF ARMY'S SELECTIVE REENLISTMENT BONUS ON RETENTION BY OCCUPATION

CONTENTS

LIST OF TABLES

LIST OF FIGURES

A MODEL OF REENLISTMENT BEHAVIOR: ESTIMATES OF THE EFFECTS OF ARMY'S SELECTIVE REENLISTMENT BONUS ON RETENTION BY OCCUPATION

Introduction

The enlisted force of the United States Army has over 200 military occupational specialties (MOS), ranging from technology intensive computer specialists, cryptologists and language specialists to leadership-intensive combat infantry. These MOS are grouped in about 35 career management fields (CMF).[1] Soldiers staffing these various occupations require different abilities and wide-ranging training, as varied as the range of skills found in the civilian economy as a whole. Moreover, by the nature of the various occupations, some have more pleasant conditions of service than others. Because of the differences and because there are unplanned changes in demand for staff in these skills, the Army must be able to provide additional financial incentives, varying by occupational specialty, for Soldiers to stay in the Army.

The Selective Reenlistment Bonus (SRB) program is the primary way the Army provides reenlistment incentives that can vary by occupational specialty. Under the SRB program, the Army sets a SRB award level (ranging from zero to eight) by MOS for Soldiers at Zone A, which is between 17 months and 6 years of active service, Zone B, which is between 6 and 10 years of active service, and Zone C, which is between 10 and 14 years of active service. The Soldier is then offered a cash bonus equal to the product of the award level, the member's monthly basic pay, and the number of years (between 3 and 6) that the member chooses to reenlist. Soldiers may receive only one SRB award while in a given zone. Until recently, the policy was to pay half of the bonus at the time of reenlistment while the remaining half was paid to the Soldier in equal installments on the anniversary of the reenlistment, over the Soldier's term of reenlistment. The policy changed in August 2004, and the Army may now specify that reenlisting Soldiers in some specialties are eligible to receive the entire bonus at the time of reenlistment.

Efficient allocation of reenlistment bonuses requires the ability to estimate the effect that the bonus will have on reenlistments in an occupational specialty. The purpose of the research reported in this paper is to provide estimates of the effect of reenlistment bonuses, at each reenlistment zone, across occupations.

Method: An Economic Model of Reenlistment Behavior

In the analysis of the effect of selective reenlistment bonuses on Army enlisted retention, we modeled the decision as a rational decision by the Soldier to remain in the Army or to leave, based on the benefits and costs associated with the alternatives. We attempted to specify empirical relationships in a way that is consistent with an underlying theory of retention behavior and the economic theory of occupational or job choice decisions. The models are limited to a single decision—stay or leave. Moreover, the decision is assumed to be a function only of current and expected future values of variables. There was no attempt to account for past

[1] See Appendix A for a list of MOS and CMF.

retention and the effects past retention may have on future retention through the selection of Soldiers surviving to the current decision.[2]

The most prominent model in this category is the Annualized Cost of Leaving (ACOL) model. Each of the Services, as well as the Office of the Secretary of Defense, the Office of Management and Budget, and the Congressional Budget Office currently use (or have used) a version of the ACOL model to predict the retention and inventory effects of changes in compensation.

Enns, Nelson, and Warner (1984) originally formulated the ACOL model to analyze the retirement reform proposal of the President's Commission on Military Compensation (PCMC). The salient problem to which the ACOL model provided a non-arbitrary solution was the *horizon* over which one compares military and civilian pay to predict the retention effects of changes. The issue of the "horizon" is particularly important in the military because of its retirement system, which is vested only after completing 20 years of service. Hence, whether a change in the retirement system affects retention at, for example, the first or second term reenlistment point depends on whether the "horizon" over which one compares military and civilian pay extends to the 20-year point, or extends only through, for example, the end of the next reenlistment term.

The ACOL solution to the horizon problem is to choose that horizon for which the annualized, or annuitized, difference between military and civilian pay is the greatest. In the literature, this is sometimes called a "maximum regret" solution, because it is based on the premise that if the individual would not reenlist for the horizon at which the ACOL difference is greatest, he or she would not reenlist for any other horizon. This solution can be derived from a simple model in which one postulates a fixed "taste for service" for a given Soldier. This dollar-denominated "taste for service" variable – which we can denote as γ_I – can be positive or negative, but is incurred by the individual each year that the individual remains in service.

The simple decision rule is: stay at least one more term if the net financial benefits to staying (military pay less civilian pay) plus the dollar value of the non-pecuniary aspects of service (the "taste" for service) exceed zero. Now, define $ACOL_h$ as the annualized difference between military and civilian pay, calculated over a horizon, h.[3]

That is, $ACOL_h$ is calculated under the assumption that the individual's decision is to remain in service for at least h more periods, enjoying military pay over those periods, or leave immediately and receive civilian pay over those periods. The horizon chosen to analyze the retention decision, h^*, is that horizon for which $ACOL_h$ is the greatest. Hence, if at the second term reenlistment decision, $ACOL$ is greatest if the horizon extends only over the period of the

[2] That is, these models do not account for the "unobserved heterogeneity" in a systematic way.

[3] Let PV(h) be the present value of the difference between military and civilian pay, calculated over horizon h:

$$PV(h) = \sum_{t=1}^{h} (M_t - C_t) / (1+r)^t$$

where M_t and C_t are military and civilian pay at period t, where t indexes time after the decision point, and r is the discount rate. Then, $ACOL_h = PV(h)D(r,h)$, where $D(.)$ is the "annuity factor" given the horizon h and discount rate r, that turns the present value of the difference into a constant annual amount over horizon h, ACOL(h), that has a present value at the decision point of PV(h).

reenlistment (typically 4 years), the $ACOL_{h*}$ will be calculated over a single term horizon. If, however, $ACOL_h$ is greatest if it includes the present value of the military retirement annuity in the calculation, the optimal horizon is likely to be that which takes the Soldier to 20 years of service, the vesting point for military retirement.[4]

The retention decision rule, then, is stay (at least one more period) if:

$$ACOL_{h^*} + \gamma_i > 0.$$

The ACOL model has been estimated using probit or logit functional forms. Research using the ACOL model has been conducted from the late 1970s to the present. There are empirical results reported in the literature for the enlisted forces of all the Services, for selected occupational groups within the enlisted force, and for many officer communities.

Somewhat more recently, a variation of the simple ACOL model sometimes referred to as a "stages" model has been developed and applied. In this variant, separate, independently estimated ACOL models are estimated for various tenure ranges or "stages" of a military career. The advantage of this approach, over that of the simple ACOL model, is that by allowing separate coefficients to be estimated over different parts of the career, potential biases from failure to account for selection effects may be reduced. That is, "average" selection can be accounted for by separate intercept and parameter estimates over various "stages" of a military career. Because our focus is on the effects of reenlistment bonuses by "zone" or stage in the military career, we adopted this "stages" approach. We recognize, however, that it is a pragmatic *ad hoc* solution to the problem of selection and unobserved heterogeneity.

A simple ACOL model approach to the Army's econometric model has the following advantages:

1. It provides a consistent structure for evaluating most types of compensation changes.
2. It solves the "horizon" problem in a reasonable, non-arbitrary way.
3. It can be used to analyze many new forms of pay and changes in the structure of compensation without requiring re-estimation.
4. It has a track record of being reasonably accurate and flexible in analyzing the most common types of compensation changes. There is a significant empirical literature from which to draw comparisons.
5. The ACOL model, in particular, is relatively straightforward to implement, is generally compatible with most inventory projection models, and has gained a degree of acceptance in the applied research and policy communities.

---

[4] If retirement is vested at the optimal leaving point, $PV(h)$ is modified to include the present value of the retirement annuity:

$$PV(h) = \sum_{t=1}^{h} (M_t - C_t)/(1+r)^t + \sum_{t=h}^{T} A_{h+i}/(1+r)^t$$

where A_{h+i} is the military retirement annuity that the Soldier begins collecting in period h, and continues to collect until death at T (with time again indexed to the decision point). Note that the entire present value of retirement is "annuitized" over the horizon h, even though the retirement annuity itself extends to T. The reason is that the annuity becomes "earned" or is vested at h, and is therefore part of the financial benefit of staying at least h more periods rather than leaving immediately.

Major weaknesses include:

1. It is a single horizon, "maximum regret" model. Compensation changes beyond the horizon have no effect on retention. As a result of this feature, it may not be able to capture the effects of some types of compensation changes.[5] (However, because the focus is on selective reenlistment bonuses, this particular limitation is not as important as it would be if the analyses were to address, for example, major changes in the retirement system.)
2. The "path independence" assumption—the feature that the ACOL model considers only current and future factors and not the past in predicting retention—implies that it will not account for the retention rate implications of unobserved heterogeneity and selection.[6] On the other hand, however, this is the Markov modeling assumption that underlies the Army's system.

We believe that, because the primary purpose of the model is to estimate the effect of reenlistment bonuses on retention decisions, the major shortcomings of the ACOL formulation are less relevant.

Calculation of the ACOL Variable

The most important explanatory variable in the model is the return to the occupation, or earnings. In theory, ACOL equals the difference between expected military earnings and alternative civilian earnings (M - C) and the value of the non-pecuniary factors affecting retention, including the "taste" component. For the estimation model, however, tastes appear implicitly in the error term. Thus, the ACOL variable used here includes two elements: military and civilian earnings.

The economic theory of occupational choice implies that individuals choose a course of action that maximizes utility over their remaining working lives. A major component of this is the income associated with a particular job or time path of jobs. This concept has implications for determining the appropriate horizon for considering a job change. In other words, an individual will not change jobs to achieve a higher immediate wage if the net present value of returns over his/her lifetime is lowered, holding non-pecuniary differences constant.

In the model, financial incentive to stay is expressed as the difference between the returns to staying in the military and the returns to leaving immediately (hence, the "cost of leaving"). The pay variable is the difference between expected lifetime earnings if the individual stays until some optimal horizon and expected earnings if he or she leaves immediately. The determination of optimal horizon is discussed below.

---

[5] In addition, a literal application of the ACOL model generates a clearly false prediction. The literal prediction is that, for a given cohort, if a future ACOL is greater than any ACOL value in the past for that cohort, the voluntary retention rate should be unity. This is because, at the earlier, lower ACOL value, all those for which $ACOL(h^*) < -\gamma_i$ will have left. For all of the remainder, $ACOL > -\gamma_i$. If the future ACOL value is greater than any ACOL value at a past decision point for that cohort the retention rate should be 100%. This implies that, as ACOL values rise as the 20-year retirement point is reached, voluntary retention rates should be unity. While they are very high, retention rates are not 100%.

[6] Recall that this "selection" issue is that future retention rates should be conditioned on the underlying "taste" distribution or the distribution of unmeasured factors of the surviving cohort. The "path independent" models do not do this.

The ACOL model is sometimes referred to as a "maximum regret" model (Arguden, 1986, p. 30). It assumes that an individual will stay if there is at least one horizon for which the returns to staying exceed the returns to leaving. The ACOL variable is defined as the maximum pay difference over all possible horizons (Warner & Goldberg, 1984, pp 14-15).[7]

To calculate the ACOL variable, assume that enlisted persons can stay in the military for a maximum of n more years, and will stay in the labor force T more years, regardless of when they leave the military.[8] Then, calculate the following variables for n possible horizons:

1. M_k = expected military pay in year k (k = 1,2,...,n).
2. W_{k0} = future potential civilian earnings from leaving immediately (k = 1,2,...,T).
3. W_{kn} = future potential civilian earnings from staying n more years, where civilian wages are conditional on n years of military experience (k = n+1,n+2,...,T).
4. r = the personal discount rate.
5. $d^k = (1/(1+r))^k$ $(k=1,...,T)$.

The *cost of leaving* (COL_n) is the discounted stream of pay differences over the T-year horizon:

$$COL_n = \sum_{k=1}^{n} M_k d^k + \sum_{k=n+1}^{T} W_{kn} d^k - \sum_{k=1}^{T} W_{k0} d^k .$$

Rearranging terms,

$$COL_n = \sum_{k=1}^{n} d^k (M_k - W_{k0}) + \sum_{k=n+1}^{T} d^k (W_{kn} - W_{k0}).$$

Finally, the pay variable must account for the fact that the present value of pay received decreases with distance from the decision point. Thus, the annualized pay difference ($ACOL_n$) is expressed as:

$$ACOL_n = \frac{COL_n}{\sum_{k=1}^{n} d^k}.$$

The ACOL value used in the estimation is:

$$\max_n \; ACOL_n = ACOL_n^* .$$

where the horizon, n, maximizes the annuitized difference between military and civilian pay.

---

[7]Note that the ACOL measure should be considered an index describing the financial incentive to stay at least one more year. The horizon associated with the maximum ACOL value is not necessarily the optimal leaving point.
[8]This specification of the pay variable is derived from Warner and Goldberg (1984), p. 27.

Conditional Logit Model

The logit model is based on the cumulative logistic probability function and is specified in Greene (1990) as:

$$P_i = F(Z_i) = \frac{1}{1 + e^{-z_i}}$$

where e is the natural base and Z_i represents the factors determining behavior. In this application, P_i represents the probability that a Soldier will reenlist and Z_i includes explanatory variables affecting the reenlistment decision, including (primarily) the ACOL value. See Mackin et al. (1996) for a more detailed derivation of the econometric model.

Data

The Army provided data on reenlistment decisions made in FY1990 through FY2000. We received annual extracts of the Enlisted Master File (EMF) for September 1989 through September 2000 and extracts of the Enlisted Loss File for the 11 fiscal years in the study. We used these data to identify Soldiers eligible to make stay/leave decisions, characterize their decisions, and generate explanatory variables for the estimation. We generated individual records for each reenlistment decision observed in the analysis period.[9] Additionally, we received copies of Army SRB messages for the analysis period and constructed a database that we subsequently used to append SRB information to individual records.

Identification of Eligible Personnel

The first step in creating the estimation data set was to identify eligible personnel. Soldiers who had an Expiration of Term of Service (ETS) date within the fiscal year were identified as eligible in that fiscal year. For example, a Soldier with an ETS date of 1 November 1992 would be included in the FY1993 sample.

Across the analysis period, however, Soldiers faced reenlistment windows of varying lengths prior to ETS. For FY1990 through FY1997, Soldiers could reenlist up to 8 months prior to ETS; after 1997, the reenlistment window expanded to 12 months prior to ETS. This policy often resulted in Soldiers reenlisting in the fiscal year prior to the one in which their ETS dates fell. These Soldiers could be identified as decision makers in either fiscal year. We chose to characterize their decisions as if they occurred in the fiscal year of their original ETS dates. A potential problem with the alternative approach relates to calculation of the ACOL variable. In general, ACOL values rise with YOS. In most cases, the ACOL value calculated at the time of reenlistment for an early reenlistee will be smaller than the ACOL calculated at the original ETS date. Because this shift would only occur for stayers (there is no corresponding provision for leaving prior to ETS), the ACOL values for stayers would be biased downward relative to the ACOL values for leavers. This, in turn, could lead to an underestimate of the true effect of pay on the reenlistment decision.[10]

---

[9] See Appendix B for a detailed discussion of data set construction.

[10] The estimation data set includes both the fiscal year to which we attributed the decision, and the fiscal year in which the reenlistment transaction occurred.

Constructing the Reenlistment Outcome Variable

We constructed a record for each eligible Soldier. The dependent variable for analysis was a binary variable equal to one if the Soldier reenlisted, and equal to zero if the Soldier left the Army voluntarily. Soldiers who separated involuntarily (e.g., death, disability) or left more than 90 days prior to ETS were censored from the final data.

A Soldier was designated as a reenlistee if he or she acquired a new enlistment date showing at least 24 months of obligation some time during the ETS window. Soldiers were characterized as losses if their loss records showed a transaction date within 90 days of ETS.

Explanatory Variables

In addition to the calculated outcome variable, the estimation data set included several calculated explanatory variables. The most important variable is ACOL. In order to calculate the ACOL value for each decision, we collected historical data on Regular Military Compensation (RMC), Selective Reenlistment Bonuses (SRB), and policies governing SRB (e.g., percentage paid lump-sum, award ceilings). Expected civilian earnings were projected using the age-earnings equation described below.

For the last two fiscal years in the analysis, targeted SRBs were available in some skills. The targeted SRB (TSRB) program paid a premium (higher SRB award) to Soldiers willing to reenlist and be assigned to hard-to-fill locations. However, it was not possible to identify specific Soldiers to whom these higher award offers were provided. In practice, any Soldier in a qualifying skill could choose one of the location premiums if it was available at the time of reenlistment. We incorporated the targeted SRB amounts into a weighted average for the skill. Weights were based on the proportion of Soldiers in a given skill who were assigned to the location with a targeted SRB.

Other explanatory variables in the estimation data set included personal characteristics (e.g., race, sex, civilian education level) and service characteristics (YOS, pay grade, MOS). Table 1 lists the variables included in the final estimation data set.

Table 1. Variables in the Estimation Data Set

Name	Description
SSN	Social Security Number
SEX	Sex
RACE	Race
DOB	Date of Birth
ETSD	Expiration of Term of Service Date
BASD	Basic Active Service Date
TYPLA	Type of Last Enlistment
ELIG	Reenlistment Eligibility
AFQT	Armed Forces Qualification Test Score
CIVEDUC	Civilian Education Level
BEPD	Basic Pay Entry Date
CMF	Career Management Field

Table 1. (Continued)

Name	Description
MARSTAT	Marital Status
NUMDEP	Number of Dependents
UIC	Unit Identification Code
REDCAT	Race/Ethnic Designation Category
DECISIONYEAR	Fiscal year in which reenlistment decision was observed
ELIGYEAR	Fiscal year in which Soldier's original ETS fell
OUTCOME	Reenlist/Loss
LOR	Length of Reenlistment
MONTHS2ETS	Months prior to ETS that Soldier reenlisted
DATLA	Date of Enlistment
DTTRAN	Date of Transaction (Loss)
SPD	Separation Program Designator
ELIGR	Reenlistment Eligibility (from Loss File)
YOS	Years of Service
PAYGRADE	Pay grade
PMOS	Primary Military Occupational Specialty
ASI	Additional Skill Identifier
LIC	Language Identification Code
SQI	Skill Qualification Identifier
LOCATION	Geographic Location Based on UIC
YOS_ZONE	The reenlistment zone (A, B or C) in which a decision fell
SRB_Award level	The SRB award level for which the Soldier was eligible
TargetedSRB	Boolean value indicating whether Soldier was eligible for targeted bonus
ACOLYOS	Horizon YOS with which ACOL value is associated
ACOL	Annualized Cost of Leaving

In Table 2, descriptive statistics are shown for the "All-Army" case, by zone.

Table 2. Descriptive Statistics for All-Army by Zone

	Zone A		Zone B		Zone C	
Variable	Mean	*SD*	Mean	*SD*	Mean	*SD*
ACOL	5,218.73	660.06	6,150.85	837.34	7,788.32	1,122.50
AFQT	58.72	19.03	56.90	19.77	54.04	20.69
No. of Obs.	739,823		351,737		178,498	
	Percentage		Percentage		Percentage	
Caucasian	65.93		56.98		50.71	
Not Caucasian	34.07		43.02		49.29	
Not HS GRAD	1.03		.39		.25	
GED	3.32		4.22		5.74	
HS Grad	84.53		76.38		59.18	
Some College	9.02		16.60		31.66	
College Grad	2.10		2.40		3.16	
Single	64.12		24.08		9.46	
Married	34.02		70.91		83.17	
Other Status	1.86		5.01		7.38	

Expected Civilian Compensation

Expectations regarding potential civilian earnings are an important part of an individual's decision to leave or remain in the military. In modeling retention decisions, it is typically assumed that the expectations of civilian earnings are formed rationally. Given the validity of this assumption, researchers can predict post-service earnings using models that link observations of actual earnings to the factors that theory suggest are determinants of those earnings—factors such as education and experience.

Using data from the Current Population Survey, March Supplement, from the years 1984 though 1998, we estimated four models of earnings for males. The results are reported in Table 3. In Model 1, the base model, all males who worked at least 35 hours per week were included. Model 2 was restricted to those who had at least a high school graduate education. Model 3 restricted observations to those who had at least a high school graduate education, but who had not completed a college degree. Finally, Model 4 included only those who were at least high school graduates but who had not completed college, and further omitted those who indicated that their occupation was managerial or professional.

Table 3. Civilian Earnings Equations

Variable	Model 1 (Base)	Model 2 (HS or >)	Model 3 (HS < ED < COL)	Model 4 NO MAN OR PROF
Intercept	5.25306	5.46813	5.40097	5.40861
	(0.00679)	(0.00651)	(0.00747)	(0.00778)
WORKEXP	0.04376	0.04751	0.05039	0.04973
	(0.000344)	(0.000393)	(0.00045)	(0.000475)
WORKEXSQ	-0.00072	-0.00084	-0.00086684	-0.00086891
	(0.000008)	(0.00001)	(0.000011)	(0.000011)
MARRIED	0.18858	0.18775	0.18411	0.18715
	(0.00235)	(0.00252)	(0.00294)	(0.0031)
BLACK	-0.14237	-0.14669	-0.14992	-0.14857
	(0.00373)	(0.00408)	(0.00449)	(0.00465)
HISP	-0.13307	-0.11936	-0.11363	-0.11103
	(0.00328)	(0.00394)	(0.00429)	(0.00449)
OTHER	-0.08201	-0.08218	-0.09364	-0.08816
	(0.005)	(0.00535)	(0.00692)	(0.0073)
HSGRAD	0.22956	———	———	———
	(0.00321)	———	———	———
SOMECOL	0.10482	0.10058	0.11395	0.11025
	(0.00258)	(0.00258)	(0.00255)	(0.00274)
COLGRAD	0.21899	0.21615	———	———
	(0.00322)	(0.00321)	———	———
SOMEGRAD	0.15198	0.15077	———	———
	(0.00388)	(0.00386)	———	———
YRDUM84	-0.03739	-0.04721	0.01218	0.01749
	(0.00526)	(0.00564)	(0.00668)	(0.00715)
YRDUM85	-0.02776	-0.03475	0.01506	0.02411
	(0.00528)	(0.00565)	(0.0067)	(0.00716)
YRDUM86	-0.00878	-0.01536	0.03823	0.04384
	(0.00529)	(0.00566)	(0.00672)	(0.00718)

Table 3. (Continued)

Variable	Model 1 (Base)	Model 2 (HS or >)	Model 3 (HS < ED < COL)	Model 4 NO MAN OR PROF
YRDUM87	-0.00813	-0.01935	0.03427	0.03674
	(0.00529)	(0.00565)	(0.00671)	(0.00717)
YRDUM88	-0.01715	-0.0262	0.02454	0.03131
	(0.00536)	(0.00572)	(0.0068)	(0.00727)
YRDUM89	-0.02188	-0.02661	0.01667	0.01971
	(0.00525)	(0.00558)	(0.00663)	(0.00709)
YRDUM90	-0.04208	-0.04778	-0.00206	-0.00070682
	(0.00527)	(0.00561)	(0.00666)	(0.00712)
YRDUM91	-0.05964	-0.06645	-0.03657	-0.03224
	(0.00529)	(0.00562)	(0.00666)	(0.00711)
YRDUM92	-0.06376	-0.06656	-0.04488	-0.04049
	(0.00532)	(0.00563)	(0.00669)	(0.00715)
YRDUM93	-0.06941	-0.07081	-0.05071	-0.05178
	(0.00538)	(0.00569)	(0.00677)	(0.00725)
YRDUM94	-0.05371	-0.05837	-0.03307	-0.0292
	(0.00536)	(0.00567)	(0.00678)	(0.00726)
YRDUM95	-0.04391	-0.04562	-0.03503	-0.03329
	(0.00553)	(0.00586)	(0.007)	(0.0075)
YRDUM96	-0.04166	-0.04249	-0.02469	-0.02045
	(0.00551)	(0.00584)	(0.00697)	(0.00748)
YRDUM97	-0.02538	-0.02433	-0.01347	-0.01158
	(0.00551)	(0.00584)	(0.00698)	(0.00749)
MANAGER	0.28737	0.29296	0.23317	———
	(0.00448)	(0.00457)	(0.00559)	———
PROF	0.17985	0.18685	0.17936	———
	(0.00483)	(0.0049)	(0.0072)	———
TECH	0.17782	0.18072	0.19188	0.19296
	(0.00638)	(0.00645)	(0.00757)	(0.00749)
SALES	0.08514	0.09533	0.0455	0.04676
	(0.00468)	(0.00479)	(0.00555)	(0.00549)
SERVICE	-0.16885	-0.14566	-0.1548	-0.15509
	(0.00488)	(0.00519)	(0.00561)	(0.00554)
FARM	-0.54052	-0.60006	-0.57372	-0.57541
	(0.00652)	(0.00753)	(0.008)	(0.00791)
CRAFT	0.08946	0.09596	0.09658	0.09712
	(0.0042)	(0.00438)	(0.00475)	(0.0047)
OPER	0.00657	0.01482	0.02297	0.02226
	(0.00493)	(0.00534)	(0.00563)	(0.00557)
TRANSP	0.03755	0.02129	0.02515	0.02565
	(0.00507)	(0.00547)	(0.00576)	(0.0057)
HANDLER	-0.14346	-0.1405	-0.12736	-0.13024
	(0.00544)	(0.00602)	(0.00629)	(0.00623)
# OF OBS.	390,446	338,230	233,009	199,760
ADJ R-SQ	0.3248	0.3005	0.2441	0.2324

The dependent variable in all models was the natural logarithm of real weekly wages. The model specified earnings as a function of experience, but allowed the effect of experience on earnings to increase at a decreasing rate by including a quadratic term for experience. Other variables included in the model were marital status, race, and broad occupational category.

For the projection of future civilian earnings of military members, we use Model Three. Almost all enlisted members are high school graduates. Many have some college, but few at Zone A, B, or C have bachelor's degrees.[11]

Estimation Results

The selective reenlistment bonus is postulated to affect reenlistment rates by increasing the financial value of remaining in the Army at least one more term. As discussed above, we measured this value using the ACOL variable, within a logit reenlistment equation. Reenlistment rates are known to vary systematically with Soldier characteristics (e.g., Smith et. al. 1991). To reduce residual variance from this source, we included Soldier characteristics in the model.

We estimated separate equations by reenlistment zone (A, B and C) and at different levels of occupational aggregation.[12] The occupational level aggregation presented proceeds from the all-Army level to the CMF level, and, finally, to the MOS level, the lowest level of occupational aggregation.

We present the results for the full model in the "All-Army" case. Thereafter, we present the results, by zone and occupational aggregation, to include the coefficient on the ACOL variable and its standard error, and the effect of a one-level increase in the SRB award level, evaluated at the mean. Full results for each equation are available upon request.

We initially tested alternative specifications of the ACOL variable, in which we varied the personal discount rate. The specifications allowed the discount rate to range between 10% and 20%. We did not find substantial differences in either estimated pay effects or overall goodness of fit for any particular discount rate. The results reported below are based on an ACOL calculated at a real discount rate of 16%. Warner and Pleeter (2001) found evidence that most enlisted personnel reveal discount rates in this range.

In general, the Zone A results indicate economically important and statistically significant effects of selective reenlistment bonuses for most CMFs and MOSs in the analysis. In Zone B and Zone C, the results are mixed. There are many CMFs and MOSs with small, but nevertheless positive and statistically significant, effects. However, there are a large number for which the effect is small and not statistically different from zero. This should not be surprising. Second and third term reenlistments are known to be relatively less responsive to changes in compensation. Historically, fewer bonuses have been targeted to Zone B and, especially, Zone C.

---

[11] The civilian earnings estimates used in the calculation of the ACOL variable vary with experience and year, but not occupation. In the ACOL variable as employed, variation is provided largely by the SRB.

[12] The estimated model was a two choice model (reenlist / don't reenlist), so extenders are technically lumped in with leavers, although we would catch a subsequent reenlistment decision in another fiscal year.

All-Army Results

We present the "All-Army" results in Table 4. From the outset, it should be recognized that estimates of the effects of SRBs at the "All-Army" level are likely to be biased low. The reason for this is that bonuses tend to be allocated to those MOS where reenlistment rates are low. Hence, an aggregate model, which pools reenlistments across MOS over time, is likely to underestimate the effect of bonuses. Though we used CMF dummy variables to control for average differences in reenlistment rates across CMF, this may not be sufficient to avoid bias.

The results for Zone A in the all-Army equation indicate that average effects of a one-level selective reenlistment bonus is to increase the first term reenlist rate by about 4.4 percentage points. The ACOL variable is positive and statistically significant, with a standard error that is quite small relative to the value of the coefficient. The model also includes the characteristics of the Soldier. In particular, women, non-whites, and married members have higher probabilities of reenlisting than do whites, males, and unmarried or separated members. Further, those with higher levels of education, beyond a high school degree, are less likely to reenlist. Those scoring higher on the Armed Forces Qualification Test (AFQT) are also less likely to reenlist.

For Zones B and C, the results are somewhat different. The estimated average effect of a selective reenlistment bonus is negligible in these zones in the aggregate model. A one level SRB at Zone B is estimated to increase Zone B reenlistments by about one percentage point, and a one level increase at Zone C results in about a 0.7 percentage point increase. The equations shown in Table 1 for Zones B and C included only an intercept term and the ACOL coefficient. When demographic variables are included in the Zone B and C equations, the effect of the ACOL variable becomes insignificant.

Table 4. All-Army Results

	Zone A		Zone B		Zone C	
	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-1.671242*	0.025760	0.598615	0.032634	1.615216	0.057211
ACOL	0.000252*	0.000004	0.000046*	0.000005	0.000037*	0.000007
Female	0.115827*	0.008973				
Non-white	0.529551*	0.006285				
AFQT	-0.006075*	0.000161				
Non-HSG	0.234435*	0.026829				
GED	0.335144*	0.015251				
Some College	-0.039076*	0.009858				
College Grad	-0.287120*	0.019977				
Separated	0.405909*	0.020303				
Married	0.498781*	0.006012				
Percentage Point Change in Reenlistment from Unit Increase in SRB Award Level	4.4		1.0		0.7	

* $p < 0.05$

None of the reported results included the national unemployment rate as an explanatory variable. We tested several specifications of the unemployment rate, including the average for all workers 16 and older, as well as some targeted more closely to the age mix found in our sample.

Unemployment effects were generally insignificant and/or negative. We do not report any of the results that include unemployment here, but do so later in the report.

CMF Level Results

We present results for equations estimated at the CMF level in Table 5.[13] The 16 CMFs we have included represent 90% of Soldiers at Zone A, 88% at Zone B, and 85% of Soldiers at Zone C (see Table 7).[14] Here, reenlistments across MOSs within a given CMF, for a given zone, are included in the estimation equation. Dummy variables were included for the MOS within the CMF to account for fixed differences in the reenlistment rates across MOS, though smaller MOSs are grouped together. We report the coefficient and standard error of the ACOL variable. Table 6 reports the effect of a one-level increase in the SRB award on the reenlistment rate (shown as a percentage point effect divided by 100). Note that, in some cases, the point estimate is zero or less. In these instances, the coefficient and effect are omitted. Note that the effects of a one-level increase in the SRB award on reenlistment rates are approximate. The precise effect will depend, *inter alia*, on the Soldier's pay grade and year of service at reenlistment. The results

Table 5. CMF ACOL Coefficient Results

	Zone A		Zone B		Zone C	
CMF	Estimate	SE	Estimate	SE	Estimate	SE
11	0.000272*	0.0000113	0.000101*	0.0000169	0.000049*	0.0000239
12	0.000228*	0.0000231	0.000074*	0.0000340	0.0000053	0.0000470
13	0.000235*	0.0000151	———	———	———	———
14	0.000211*	0.0000384	0.000153*	0.0000452	0.0000360	0.0000557
19	0.000306*	0.0000188	0.000087*	0.0000268	———	———
31	0.000212*	0.0000159	———	———	0.0000388	0.0000238
51	0.000397*	0.0000327	———	———	0.0000451	0.0000547
63	0.000248*	0.0000123	———	———	———	———
67	0.000390*	0.0000331	0.000102*	0.0000244	0.000094*	0.0000406
71	0.000413*	0.0000187	———	———	———	———
74	0.000022	0.0000533	———	———	———	———
77	0.000239*	0.0000269	0.0000066	0.0000354	———	———
88	0.000269*	0.0000224	———	———	———	———
91	0.000257*	0.0000183	0.0000190	0.0000169	0.0000021	0.0000234
92	———	———	———	———	0.0000765*	0.000033
94	0.000218*	0.0000289	———	———	0.0000212	0.0000538
95	0.000245*	0.000023	———	———	0.000032	0.00003
96	0.000171*	0.0000374	0.0000507	0.0000415	0.0001124*	0.000047
98	0.000069*	0.0000328	0.000111*	0.0000406	0.0001089*	0.000044

*$p < .05$.

[13] See Appendix A for the MOS comprising each CMF.

[14] Note that what is reported is the proportion of total observations in the data set across all estimation years that are covered by the equations estimated. This approximates the proportion of total Zone A through Zone C Soldiers included in the CMF equations.

for Zone A indicate that reenlistment bonuses for almost all CMFs have an important effect on reenlistment rates, generally adding between one and seven percentage points to the rate for a one level increment in the bonus for most CMFs. The estimated effects for Zones B and C are smaller, and in some cases zero or less.

Table 6. Effect of One-Level Increase in SRB, CMF Level

CMF	Zone A	Zone B	Zone C
11	0.0455	0.021493	0.00869
12	0.0385	0.01664	0.00079
13	0.002333	———	———
14	0.036167	0.03328	0.0079
19	0.051333	0.018027	———
31	0.03675	———	0.00869
51	0.06825	———	0.01027
63	0.043167	———	———
67	0.067667	0.024267	0.01738
71	0.06825	———	———
74	0.004083	———	———
77	0.042	0.001387	———
88	0.04725	———	———
91	0.044917	0.00416	0.00079
92	———	———	0.01264
94	0.037917	———	0.00474
95	0.042583	———	0.00711
96	0.02975	0.011093	0.02449
98	0.011667	0.026347	0.02686

Table 8 includes the results for a different specification of the CMF level models. Instead of estimating the effects at Zone A, B, and C through separate equations for each CMF, decisions at the three zones are pooled for each CMF. Then, the model is estimated with a coefficient on the ACOL variable that is constrained to be the same at all three decision points. Separate intercepts for each zone are included in the model. When the decisions are pooled and a single ACOL coefficient is estimated for the three zones, we find that, generally, the effect on the reenlistment rate of a one level SRB increase at Zone A is lower than in the previous estimates, while the effect at Zones B and C rises. All of the SRB effects are now positive across all zones, except for CMF 92.

Table 7. Proportion of Observations by CMF and Zone

CMF	Zone A	Zone B	Zone C
11	15.96	9.73	8.88
12	3.48	2.33	2.27
13	8.64	6.16	6.13
14	2.06	1.49	1.63
19	5.68	3.96	4.47
31	7.03	7.10	7.37
51	1.71	1.66	1.59
63	11.99	11.20	10.68
67	1.57	4.92	3.57
71	5.06	7.89	7.88
74	.78	1.62	1.31
77	2.45	2.15	1.66
88	3.72	3.99	4.08
91	6.7	9.09	8.13
92	4.92	5.79	5.56
94	2.35	1.71	1.53
95	3.27	4.32	4.30
96	1.26	1.63	1.95
98	1.76	1.65	1.91
Total	90.39	88.39	84.90

Table 8. CMF ACOL Coefficient Results (Constrained Across Zones)

	ACOL		Effect of One-Level SRB Increase		
CMF	Estimate	Standard Error	Zone A	Zone B	Zone C
CMF 11	0.000181*	0.000009	0.030217	0.039035	0.032153
CMF 12	0.000155*	0.000017	0.026192	0.034181	0.03081
CMF 13	0.000096*	0.000011	0.016275	0.020939	0.018644
CMF 14	0.000138*	0.000025	0.023625	0.031269	0.031205
CMF 19	0.000174*	0.000014	0.029225	0.036053	0.032627
CMF 31	0.000057*	0.000010	0.009858	0.013243	0.012482
CMF 51	0.000170*	0.000022	0.029342	0.040144	0.03792
CMF 63	0.000147*	0.000008	0.025631	0.0338	0.032772
CMG 67	0.000213*	0.000007	0.021809	0.0367	0.046351
CMF 71	0.000089*	0.000011	0.0147	0.017472	0.0158
CMF 74	———	———	———	———	———
CMF 77	0.000132*	0.000020	0.0231	0.028635	0.025912
CMF 88	0.000108*	0.000015	0.0189	0.022464	0.020619
CMF 91	0.000086*	0.000011	0.01505	0.015253	0.013351
CMF 92	———	———	———	———	———
CMF 94	0.000083*	0.000021	0.014525	0.01872	0.017143
CMF 95	0.000063*	0.000014	0.010908	0.015323	0.014615
CMF 96	0.000105*	0.000023	0.018258	0.022395	0.022752
CMF 98	0.000067*	0.000022	0.011317	0.0156	0.016037

*$p < 0.05$.

MOS Level Results

Table 9 presents the results for equations estimated at the MOS level. We included the 20 largest MOS, which represent about 55% of Soldiers at Zone A, 47% at Zone B, and 46% of Soldiers at Zone C (see Table 11). Once again, the results for Zone A reveal economically important and statistically significant effects for all but three MOS. The effect of a one-level increase in SRB award (shown in Table 10) ranges from a 6.7 percentage point increase in the reenlistment rate for MOS 71L to 1.6 percentage points for MOS 91B. The results for Zones B and C are, at best, mixed.

Table 9. MOS ACOL Coefficient Results

	Zone A		Zone B		Zone C	
MOS	Estimate	SE	Estimate	SE	Estimate	SE
11B	0.000235*	0.000015	0.000093*	0.000023	0.000065*	0.000032
11C	0.000240*	0.000032	0.000028	0.000054	———	———
11M	0.000326*	0.000023	0.000120*	0.000033	0.000039	0.000047
12B	0.000232*	0.000025	0.000039	0.000038	———	———
13B	0.000248*	0.000020	———	———	———	———
19D	0.000351*	0.000031	0.000024	0.000044	———	———
19K	0.000277*	0.000024	0.000139*	0.000035	———	———
31U	———	———	———	———	0.000219	0.000074
52D	0.000301*	0.000036	———	———	———	———
54B	0.000321*	0.000039	0.000151*	0.000048	———	———
63B	0.000171*	0.000024	———	———	———	———
71L	0.000406*	0.000030	———	———	———	———
76Y	0.000226*	0.000056	———	———	———	———
77F	0.000236*	0.000028	———	———	———	———
88M	0.000294*	0.000027	0.000033	0.000031	———	———
91B	0.000094*	0.000029	———	———	———	———
92A	———	———	———	———	———	———
92Y	———	———	———	———	0.000188*	0.000056
94B	0.000216*	0.000029	———	———	———	———
95B	0.000230*	0.000023	———	———	0.000034	0.000033

*$p < 0.05$.

Table 10. Effect of One-Level Increase in SRB, MOS Level

MOS	Zone A	Zone B	Zone C
11B	0.039317	0.020107	0.011139
11C	0.040017	0.005824	———
11M	0.054483	0.026139	0.006873
12B	0.039492	0.008667	———
13B	0.042408	———	———
19D	0.0588	0.004923	———
19K	0.046725	0.028912	———
31U	———	———	0.047242
52D	0.052325	———	———
54B	0.056175	0.02912	———
63B	0.029925	———	———
71L	0.066733	———	———
76Y	0.039492	———	———
77F	0.0413	———	———
88M	0.051392	0.006725	———
91B	0.01645	———	———
92A	———	———	———
92Y	———	———	0.027255
94B	0.0378	———	———
95B	0.039842	———	0.007663

As suggested previously we did not estimate positive and statistically significant effects for many Zone B and Zone C CMFs and MOS because there is little variation in Zone B and Zone C bonuses. Within a zone, variation in the SRB provides the variation in pay necessary to estimate an effect on reenlistments. Without such variation, estimation of effects becomes difficult. We have seen, however, that if we pool observations across zones (Table 8), thus gaining additional variation in the financial incentive to stay, we do obtain significant results for Zones B and C.

Table 12 shows the mean and standard deviation in the bonus award level, by zone, in the All-Army case. Note that the means of the bonus award level at Zone B and Zone C are significantly lower than the Zone A mean award level. Similarly, the standard deviation in the bonus award level is lower at Zones B and C compared to A. At the CMF level, Table 13 indicates that both the mean and standard deviation in bonus award levels also decline as one moves from Zone A to Zone C.

Table 11. Proportion of Observations by MOS and Zone

MOS	Zone A	Zone B	Zone C
11B	8.83	5.39	4.93
11C	1.79	1.04	0.96
11M	3.83	2.54	2.33
12B	2.88	1.86	1.79
13B	4.75	3.28	3.09
19D	2.09	1.46	1.50
19K	3.47	2.35	2.80
31U	1.07	1.23	1.10
52D	1.32	1.34	1.12
54B	1.18	1.31	1.90
63B	3.19	2.92	3.06
71L	2.05	2.99	2.80
76Y	1.09	1.17	1.60
77F	2.23	1.89	1.43
88M	2.78	2.97	3.11
91B	3.31	3.29	2.80
92A	1.81	2.49	2.24
92Y	1.68	1.88	2.13
94B	2.35	1.71	1.53
95B	3.11	3.93	3.65
Total	54.81	47.04	45.87

Table 12. SRB Award Level Means and Standard Deviations by Zone (All-Army)

Zone	Mean	SD
A	0.35882530	0.67069953
B	0.12351497	0.43058378
C	0.00227818	0.05327775

Table 13. SRB Award Level Means and Standard Deviations by Zone And CMF

	Zone A		Zone B		Zone C	
CMF	Mean	SD	Mean	SD	Mean	SD
11	0.4869	0.5916	0.1962	0.4912	0.0000	0.0000
12	0.2359	0.3857	0.1105	0.3219	0.0000	0.0000
13	0.4121	0.6644	0.0854	0.342	0.0005	0.0331
14	0.8351	1.1119	0.0858	0.3611	0.0000	0.0000
19	0.3662	0.5292	0.1176	0.5104	0.0180	0.1331
31	0.1033	0.388	0.0299	0.2031	0.0000	0.0000
51	0.2485	0.5183	0.0437	0.2712	0.0000	0.0000
63	0.1984	0.5047	0.0216	0.1512	0.0016	0.0403
67	0.3498	0.7784	0.0531	0.2614	0.0003	0.0177
71	0.0121	0.0802	0.0242	0.1435	0.0000	0.0000
74	0.1287	0.4159	0.1412	0.4853	0.0021	0.0463
77	0.1277	0.3205	0.0212	0.1361	0.0000	0.0000
88	0.1126	0.3059	0.0326	0.1753	0.0000	0.0000
91	0.2378	0.6359	0.1479	0.5049	0.0000	0.0000
92	0.1917	0.4457	0.0489	0.2	0.0000	0.0000
94	0.5946	0.491	0.5372	0.4987	0.0000	0.0000
95	0.2425	0.5658	0.0206	0.1187	0.0000	0.0000
96	1.0969	1.2107	0.2900	0.6784	0.0308	0.2197
98	1.8659	1.4143	1.0208	1.1081	0.0073	0.0853

Effects of Targeted SRB (TSRB)

Starting in FY1998, the Army began to target SRBs in certain key skills to specific locations. The TSRB program is designed to help fill less-desirable assignments. We attempted to measure the differential impact of the TSRB, but we were presented with a number of obstacles to doing so. First, the TSRB is generally available to any Soldier in the target skill who is willing to accept an assignment to the targeted location. Therefore, there is no way to distinguish the eligible pool from those eligible for a regular SRB. Second, use of the TSRB is typically demand-constrained. When the desired number of volunteers for a particular location has been obtained, the TSRB for that location is turned off. Third, empirical evidence for the TSRB covers only about two years of our sample, thus limiting the number of observations available for analysis. For these reasons, we did not estimate a separate effect of the location-specific selective reenlistment bonus.

Comparison with the Literature

Goldberg (2001) provided estimates of the effect of a one-level increase in the SRB award level from studies conducted in the 1980s and 1990s. We compared our estimates to those from the studies reported in Goldberg's paper. Several factors should be considered in the comparison. First, because high-retention occupations are typically offered lower bonus award levels than low-retention occupations, estimates that are based on cross-sectional variation in bonus award levels are likely to biased downward. Second, the effect of a one-level SRB increase will depend on whether the bonus is paid as an installment, lump sum, or half installment and half lump sum. All else being equal, the effects will be greatest for lump sum bonuses, second largest for half lump sum and half installment payments, and lowest for installment payments. Third, the real value of military basic pay in the

simulation of the effect will affect the estimate. The higher the real value, all else being equal, the larger will be the effect of a one-level SRB increase in the reenlistment rate.

Goldberg (2001) reported results of a one-level SRB decrease when the bonuses are paid under annual installments. Our results are for bonuses paid as half lump sum at the time of reenlistment and the other half in installments over the reenlistment term. To make the two comparable, we increased the size of the installment bonus effects by 7.83%.[15] We made similar adjustments to other studies, as appropriate. We compared results for Zone A SRB only.

The comparison results are shown is Table 14. Most of the previous estimates are for Navy enlisted personnel. The Navy has traditionally had the highest SRB budget. Our estimate of the effect of a one-level increase in SRB award level from the Zone A All-Army model is higher than the estimates in the literature. The range of estimates we compute at the occupational levels, however, is within the range found in the literature. Because we provided estimates at a lower level of occupational aggregation and for a larger number of occupations, compared to most other studies, our range is both higher than the literature on the "high" side of the range and lower than the literature on the "low" side of the range.

Table 14. Comparison of SRB Effects to other Studies

Author	Service	Effect Range (percentage point increase in reenlistment rate)
Cooke, Marcus, & Quester (1992)	Navy	2.7
Goldberg & Warner (1982)	Navy	1.6-3.2
Hosek & Peterson (1985)	Four Services	1.94
Mackin et. al. (1996)	Navy	.43-3.0
Smith, Sylwester, & Villa (1991)	Army	2.37
Warner & Goldberg (1984)	Navy	1.9-5.9
Hogan, Espinosa, Mackin, & Greenston (2002; revised 2005)	**Army -MOS**	**1.6-5.6**
	Army -CMF	**0.2-6.8**

Hansen argues that with such a large variance across occupations in these estimates, it is not surprising that there is overlap from one study to the next, and that the appropriate comparison is between the All-Army estimate reported above and the rule-of-thumb in Goldberg (2001, p. 62).[16] When this comparison is made, our All-Army estimate is about twice the size of the consensus drawn from earlier studies. Our estimates can also be compared to those reported earlier for the Army by Smith et al. for Infantry (11), Mechanical Maintenance (63), and Administration (71): the estimated effects reported here are about 70% higher for Zone A.[17]

[15] This increase is based on the percentage difference in the present value of a bonus paid for a 4-year reenlistment when paid as installments compared to payment as 50% lump sum, at a 16% discount rate.

[16] Communication from Michael Hansen, Center for Naval Analyses, August 2002.

[17] Our study included some environmental factors not present in many of the others, including the downsizing of the 1990s and the economic boom of the late 1990s. However, we don't have any priors on which direction these factors might have pushed the pay elasticities.

Out of Sample Forecasts and a Revised Model

The estimates of the effects of SRB on the reenlistment rate were tested by using the ACOL coefficients estimated in the models to predict Army reenlistment rates in a way that is similar to the way the estimates will actually be used in an SRB planning model.[18] The primary personnel datasets used in the validation of the SRB model were:

- Soldiers eligible to reenlist ("eligibles" file) in FY2001 and FY2002,[19]
- Soldiers who received an SRB ("takers" file) in FY2001 and FY2002,

We apply the estimates of the effect of bonuses on reenlistment rates in the context of the SRB policy model in which they will be used. This policy model begins with a baseline reenlistment rate for each MOS and reenlistment zone, then predicts the new reenlistment rate as a function of the differences in compensation, including SRB, and other variables from the "baseline." A difficulty in this "out of sample" prediction test is that there are two sources of potential error. First, coefficients from the behavioral model may be in error. Hence, for a given change in compensation, the model may predict a change in reenlistments that differs from the change that is realized. Second, the model's predictions of reenlistments are conditional on the "eligible" population. Errors in determining the eligible population will introduce prediction errors that are not directly related to the coefficients of the behavioral model.

We adjusted the variables of the model to capture the conditions of the test years. The parameters and pay tables were adjusted to their FY2001 and FY2002 levels. This adjustment also entailed providing the inventory of Soldiers eligible for an SRB in the plan year.

The SRB policy model uses baseline SRB reenlistment or "take-rates" to project reenlistment rates in the plan year, and these rates are applied to the plan-year inventory of those eligible to reenlist. The FY2001 file of those eligible to reenlist and those who did reenlist provides the baseline reenlistment rates in this test.

Policy Model Predictions

Forecasts are based on the "best" set of parameter estimates as defined by the following hierarchy:

1. MOS level estimates if they were available for the MOS, and were of the right sign and statistically significant.
2. CMF level estimates for the remaining MOS, if the CMF estimated of the ACOL coefficient was of the right sign and statistically significant.
3. All-Army level estimates for the remaining MOS.

---

[18] The SRB model projects the reenlistment rate as a difference from the "baseline" of the previous period's observed rate. The actual econometric model estimated includes demographic and other variables. The out-of-sample data set does not support these additional variables. For this reason, and because the econometric results will actually be used in the SRB model that does not include these additional variables, we used the "baseline" method for comparing the projections to actual estimates using out-of sample actual data.

[19] FY2001 eligibles are based on the FY2002 SRB Plan. That is, we calculated baseline reenlistment rates for the FY2001 population for those occupations that would be offered an SRB in FY2002.

After all the parameters are adjusted, the policy model recalculates baseline (FY2001) and projected (FY2002) ACOL values, which in turn are used to project FY2002 reenlistment rates. These reenlistment rates are applied to the eligible counts for each occupation to produce the number of projected reenlistments for each job category in FY2002. Our analysis, which is summarized below, compared these projections to the actual outcomes (i.e. the number of actual reenlistments). Table 15 shows the aggregate results of the SRB model run and the "actual" information, for comparative purposes, based on 208 MOS.

Table 15. Eligibles, Reenlistments, and Aggregate Reenlistment Rates (Actual and Model Results)

	Eligibles	Reenlistments	Reenlistment Rate
Actual	58,259[a]	9,999	17%
Predicted	*52,237*	*10,443*	*20%*

[a] In practice, "actual' eligibles are not known with certainty, even after the fact. Reenlistees or "takers" can be known with certainty after the fact. "Actual" eligibles are equal to predicted eligibles plus the "takers" or reenlistees who actually received a reenlistment bonus, but were not included in the predicted "eligibles" because they appear to be outside the normal window of eligibility.

The SRB model reports a different eligible count, because it takes into account pay grade and year of service (YOS) restrictions on reenlistment. For example, there may be a Soldier with more than 6 YOS. Since the Soldier is technically outside of Zone A, the model does not report this individual as eligible. However, the Soldier may have reenlisted and received an SRB.[20]

As Table 15 illustrates, the SRB model estimates the aggregate number of reenlistments to within 5% of the actual number of reenlistments. However, the standard deviation of residuals, about 13.8 percentage points, is not insubstantial. Moreover, the estimates overstate the reenlistment rate by about two percentage points, on average.

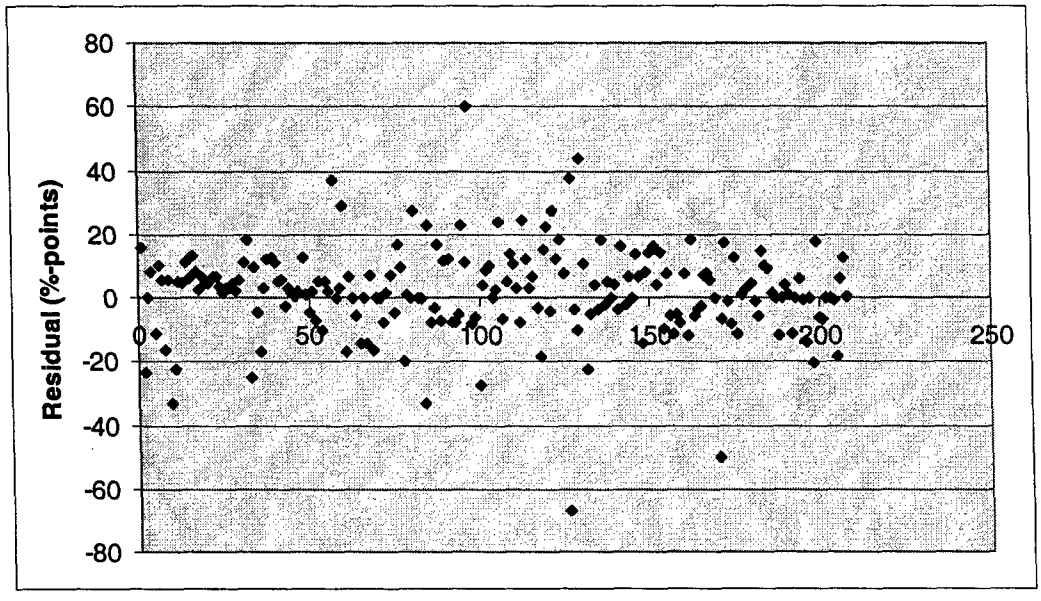

Figure 1. Residuals–predicted rates minus actual rates, by MOS.

[20] Note that there is not an "actual" or definitive set of eligibles in the data.

The predicted versus actual reenlistment rates by MOS are shown in Appendix D. Figure 1 is a scattergram of the percentage-point residuals. This figure shows that the SRB model seems to over-predict, on average.

Table 16 shows a breakdown of the percentage-point residuals. In this table "R" is the absolute value of the residual in percentage points. The model predicts within 15 percentage points of the actual take-rate for 80% of the occupations. These occupations account for approximately 95% of those who received an SRB and 91% of the reenlistment eligible population.

Table 16. Categorizing Absolute Residuals (percentage points)

	R < 10%	10%<R<15%	15%<R<25%	25%<R
Occupations	128	38	28	14
% of Total	62%	18%	13%	7%
Takers	6,411	3,545	394	90
% of Total	61%	34%	4%	< 1%
Eligibles	34,680	13,241	4,018	298
% of Total	66%	25%	8%	< 1%

Comparison Limited to MOS with SRB in Both Periods

A problem in the "baseline" approach is that, because those eligible to reenlist must be inferred based on rules, error is introduced that is not due to the econometric model itself, but rather due to errors in defining the underlying eligible population. These errors are likely to be greater when the MOS is not offered an SRB in the baseline period, in the prediction period, or both. To reduce this source of error, we evaluated the SRB model's effectiveness in forecasting reenlistment rates when we limit the forecasts to MOS that are offered positive SRB levels in both the baseline and plan years.

Under this modification, there are many skills that we excluded from the analysis because there was not an SRB offered to that skill in the baseline year, plan year, or both. Of the 208 skills initially considered, there are 165 (80%) skills that received an SRB in the baseline and plan year. These 165 skills account for 44,841 (86%) of the 52,237 observations eligible for an SRB in 2002.

We found that this modification produced significantly better results than the previous analysis that included all skills, regardless of whether they received an SRB in both periods. To judge the improvement, we considered the residual of the forecasted reenlistment rate by comparing it to the "actual" 2002 reenlistment rate for those skills that received an SRB in the baseline and plan years. We found that under the modified methodology presented above, the SRB model performs better than in earlier testing. For example, the SRB model's forecasted rates differ from the actual rates by an average of -0.80 percentage points and the median residual is 0.1 percentage points. Using all the MOS resulted in an average residual of 4.00 percentage points and a median residual of 2.41 percentage points. For both methodologies, the standard deviation of the residuals was about the same.

Comparison to a "Naive" Model

Comparisons of the predicted rates to the actual rates are important, but to better understand the model's contribution, it is useful to compare its predictions to an alternative model. In this case, we compared the estimated model's predictions to a "naive" model. The "naive" model is one that predicts that the current reenlistment rate for a given occupation will equal the previous period's reenlistment rate for that occupation.

In this "naive" model, we set the 2002 forecasted reenlistment rate equal to the 2001 rate. As a measure of performance, we computed the residual of the forecast; that is, we computed the difference between the 2002 predicted rates and the 2002 actual rates and provided descriptive statistics of this residual value.

We found that the "naive" model did not perform as well as the estimated SRB policy model. The "naive" model had an average residual of 5 percentage points and a 4 percentage point median difference. The SRB policy model had an average residual of 2 percentage points and a 2.4 percentage point median difference. The actual (estimated) model does improve significantly upon the "naive" model.

Controlling for the Drawdown and Revised Estimates

The out-of-sample tests indicate that the estimated econometric SRB model performs significantly better than a "naive" model, but that the econometric model can be improved. In particular, in the current model, the factors affecting reenlistment decisions do not include the overall status of the civilian labor market, as measured by the unemployment rate.

Based on the underlying theory of retention behavior, the original model assumes the decision to reenlist is a rational decision based on the benefits and costs associated with the alternatives. The most important explanatory variable is the ACOL variable that represents the maximum of annualized differences between military and civilian pay for each Soldier. In addition, the model includes Soldiers' demographic characteristics including gender, race, education, AFQT, and marital status.

The most important difference between the model originally estimated and the revised version is that, in the latter, we explicitly controlled for the period in which the Army was "downsizing" its force level. In particular, we included a dummy variable to represent the pre-drawdown period of 1990-1991 and the post drawdown period from 1997 through 2000 of our data set. By including the dummy variables, we were able to measure the effect of the civilian labor market on retention, an effect that was obscured by the effects of the drawdown on voluntary retention.[21] To improve the model, we added the national unemployment rate. By controlling for the period of the drawdown, during which Soldiers may have been encouraged

[21] The econometric estimates of the effects of various factors on retention assume that retention decisions are largely voluntary. When other factors, such as those undertaken during the drawdown, affect retention but are not measured in the econometric equations, the possibility of biased and/or inefficient estimates arises. The failure to account for the drawdown is most likely the reason the effects of the unemployment rate could not be measured with precision in the original estimates and was not included in the original model.

not to reenlist, we were able to estimate the effects of the economy on voluntary reenlistment decisions. When the civilian job market is tight, characterized by a low unemployment rate, there will be better civilian opportunities for Soldiers, inducing some to leave. Conversely, when the civilian economy is weak, characterized by high unemployment rates, more Soldiers will choose to reenlist. However, this relationship may have been obscured by the drawdown, during which some Soldiers were encouraged not to reenlist. By controlling for this period, the relationship between the reenlistment decision and the state of the labor market may be estimated.

Revised Reenlistment Model Estimation Results

The estimation results of the revised model are noticeably improved compared to those of the original model. With the inclusion of the drawdown dummy variables and the unemployment rates, we obtained statistically significant and correctly signed coefficients on the ACOL variables in a greater number of equations, and we also obtained significant results for unemployment in many cases. At the All-Army level, as indicated in Table 17, almost all explanatory variables are significant in the equations for all three zones. These results appear to be an improvement over the original model where the significance of the ACOL variable was sensitive to the inclusion of demographic variables.

Table 17. All Army Results of the Revised Reenlistment Model

	Zone A		Zone B		Zone C	
	Estimate	SE	Estimate	SE	Estimate	SE
Intercept	-2.2968***	0.0734	-0.7931***	0.082	3.5492***	0.1243
ACOL	0.000361***	0.000007537	0.000209***	0.000006901	0.000075***	0.000008343
Unemployment Rate	0.0299***	0.00525	0.0145**	0.00689	-0.3517***	0.0112
AFQT	-0.00535***	0.000157	-0.00047**	0.000229	-0.00392***	0.000403
Female	0.2513***	0.00845	0.00248	0.0126	-0.0283	0.0235
Non-white	0.5625***	0.00618	0.3586***	0.00915	0.2076***	0.0166
Separated	-0.07***	0.0205	-0.1012***	0.0189	-0.2035***	0.0273
Single	-0.495***	0.00633	-0.1786***	0.0102	-0.1632***	0.0252
GED	0.508***	0.0245	-0.2955***	0.0335	-0.4353***	0.0528
HS Grad	0.2323***	0.0197	-0.1734***	0.0277	-0.3202***	0.0448
Non-HSG	0.4358***	0.0332	-0.4694***	0.068	-1.1724***	0.1242
Some College	0.2329***	0.0213	0.1819***	0.0291	0.1957***	0.0458
Post-drawdown	0.5818***	0.0138	0.4245***	0.0172	-0.4688***	0.0292
Pre-drawdown	0.2318***	0.012	0.8596***	0.0155	0.5742***	0.025
Percentage Point change in reenlistment rate from a one-level increase in SRB award level	6.4		4.5		1.8	

** $p < .05$, *** $p < .01$

We re-calculated the responsiveness of the re-enlistment rate to the change in SRB, based on the following equation:

$$\partial R / \partial SRB = (\partial R / \partial ACOL) * (\partial ACOL / \partial SRB)$$

where R is the reenlistment rate, SRB is the selective reenlistment bonus award level, and ACOL is the annualized cost of leaving.

The responsiveness of reenlistment to SRB at the all-Army level, as reported in the bottom row of Table 17, is greater than in the original estimates. The average effect of a one-level increase in SRB is to increase the first term reenlistment by about 6.4 percentage points, the second term by about 4.4 percentage points, and the third term by about 1.8 percentage points. The estimated effects for the unemployment rate and drawdown dummies are as expected; that is, higher unemployment rates are associated with higher reenlistment rates and the reenlistment rate dropped during the drawdown (except for Zone C.) Effects of the demographic variables are similar to the original estimates for Zone A. Women, non-whites, and married members have higher propensity to reenlist; and college graduates have the lowest propensity to reenlist. (Recall that no demographic variables behaved 'well' for Zones B and C in the original model.) However, the education effect is different for Zone B and Zone C in the revised model, where college graduates and members with some college are *more* likely to reenlist.

We also estimated the model and calculated the SRB effect of reenlistment at the CMF level and the MOS level. Table 18 presents the estimates of the ACOL coefficient for the largest 19 CMF, and Table 19 reports the effect of a one-unit increase in the SRB award level. In Zone A, at the CMF level, the effect of a one unit SRB level increase ranges from about 0.4 percentage points to about 10 percentage points. Similarly, Table 20 and Table 21 show the ACOL coefficients for the largest 20 MOS and the bonus effect, respectively. In Zone A, at the MOS level, the effect of a one unit increase in SRB ranged from about 2 percentage points to about 11 percentage points. We omitted the coefficient if the ACOL coefficient was negative. Note that, for the most part, this occurred infrequently and was largely confined to Zone C. We then compared the new results with the original results in Table 22. There is a significant improvement of the revised model at both the CMF and MOS level and across all zones.

Table 18. ACOL Coefficient of the Largest 19 CMF

	Zone A		Zone B		Zone C	
CMF	Estimate	SE	Estimate	SE	Estimate	SE
11	0.000397***	0.00002	0.000302***	0.000023	0.000128***	0.000029
12	0.000247***	0.00004	0.000224***	0.000047	0.000108*	0.000059
13	0.000399***	0.000026	0.000254***	0.000028	0.000076**	0.000035
14	0.000197***	0.000051	0.000196***	0.000056	----------	----------
19	0.00051***	0.00003	0.000253***	0.000036	0.000129***	0.000041
31	0.000305***	0.000029	0.000183***	0.000026	0.000088***	0.00003
51	0.000374***	0.000059	0.000193***	0.000054	0.000095	0.0.0066
63	0.00027***	0.000021	0.000172***	0.00002	0.000053**	0.000026
67	0.000387***	0.000064	0.000321***	0.00003	0.000104**	0.000045
71	0.000448***	0.000034	0.000109***	0.000026	----------	----------
76	0.000644***	0.000064	0.000277***	0.00005	0.000035	0.000049
77	0.000124***	0.000045	0.000243***	0.000049	----------	----------
88	0.000239***	0.000039	0.000196***	0.000036	----------	----------
91	0.000458***	0.00003	0.000154***	0.000022	0.000079***	0.000028
92	0.000178***	0.000028	0.000178***	0.000028	0.000043	0.000038
94	0.000688***	0.000068	0.000258***	0.000059	0.000186**	0.000072
95	0.000291***	0.000039	0.000206***	0.000032	0.000136***	0.000036
96	0.00017**	0.000067	0.000161***	0.000054	0.000203***	0.000059
98	0.00027***	0.000059	0.000153***	0.000054	0.000177***	0.000054

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 19. Effect of One-Level Increase in SRB, CMF Level

CMF	Zone A	Zone B	Zone C
11	0.066410	0.064266	0.029539
12	0.041708	0.050370	0.024924
13	0.003961	0.056037	0.017539
14	0.033767	0.042633	----------
19	0.085555	0.052423	0.029770
31	0.052871	0.040373	0.019709
51	0.064296	0.042579	0.021633
63	0.046996	0.037946	0.012231
67	0.067146	0.076370	0.019229
71	0.074034	0.024047	----------
74	0.105396	0.061111	0.008077
77	0.021791	0.051067	----------
88	0.041980	0.043241	----------
91	0.080047	0.033718	0.029719
92	0.029131	0.039270	0.007105
94	0.119665	0.056919	0.041587
95	0.050578	0.045447	0.030218
96	0.029576	0.035226	0.044230
98	0.045653	0.036316	0.043657

Table 20. ACOL Coefficients of the Largest 20 MOS

	Zone A		Zone B		Zone C	
MOS	Estimate	SE	Estimate	SE	Estimate	SE
11B	0.000387***	0.000028	0.000302***	0.000031	0.000171***	0.00004
11C	0.000306***	0.000059	0.000296***	0.000072	----------	----------
11M	0.000415***	0.000038	0.000269***	0.000043	0.000095*	0.000056
12B	0.000215***	0.000043	0.000205***	0.000052	0.000084	0.000067
13B	0.000589***	0.000036	0.00026***	0.000039	0.00007	0.000049
19D	0.000678***	0.000051	0.00023***	0.000059	0.000124*	0.000073
19K	0.000419***	0.000038	0.000292***	0.000046	0.000093*	0.000052
31U	0.000274***	0.000063	0.000209***	0.000058	0.00016*	0.000086
52D	0.00026***	0.000068	0.000124**	0.000059	0.000061	0.000086
54B	0.000364***	0.000072	0.000222***	0.000063	0.00001	0.000059
63B	0.000195***	0.000042	0.000189***	0.000041	0.00000003646	0.000048
71L	0.000463***	0.000055	0.00009**	0.000042	----------	----------
76Y	0.000679***	0.000107	0.000327***	0.000083	0.00009	0.000075
77F	0.000108**	0.000047	0.00024***	0.000053	----------	----------
88M	0.00024***	0.000047	0.000201***	0.000042	----------	----------
91B	0.000323***	0.000041	0.000018	0.000039	----------	----------
92A	0.000198***	0.000047	0.000229***	0.000042	----------	----------
92Y	----------	----------	0.00023***	0.000051	0.000158**	0.000066
94B	0.000697***	0.000068	0.000261***	0.000059	0.000185**	0.000072
95B	0.000253***	0.000041	0.000196***	0.000033	0.000108***	0.00004

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 21. Effect of One-Level Increase in SRB, MOS Level

MOS	Zone A	Zone B	Zone C
11B	0.064748	0.065294	0.029304
11C	0.051022	0.061568	----------
11M	0.069357	0.058595	0.016742
12B	0.036598	0.045557	0.015686
13B	0.100719	0.054406	0.013071
19D	0.113579	0.047179	0.023155
19K	0.070678	0.060736	0.017366
31U	0.046976	0.043734	0.034515
52D	0.045198	0.025947	0.011391
54B	0.063700	0.042812	0.001867
63B	0.034125	0.039549	0.000007
71L	0.076102	0.018833	----------
76Y	0.118651	0.068426	0.016806
77F	0.018900	0.050221	----------
88M	0.041953	0.040961	----------
91B	0.056525	0.003767	----------
92A	0.033946	0.047919	----------
92Y	----------	0.048128	0.022906
94B	0.121975	0.054615	0.034546
95B	0.043826	0.041014	0.024341

Table 22. Comparison of the ACOL Coefficients: Revised and Original Model Estimation

		No. of results statistically significant and positive					
		CMF level			MOS level		
	Specification	Zone A	B	C	Zone A	B	C
Revised model	Has unemployment rate & drawdown year dummies	19	19	12	19	19	8
Original model	No unemployment rate or year dummies	17	6	5	17	4	2

As a final comparative exercise, we predicted the reenlistment rate for each year group under the revised model and under the original model. Subtracting the actual rates from the predicted rates (calculated using the same data) yields the residuals of the prediction. We did this for Zone A because while both models seem to have yielded reasonably good results for Zone A, the original model did not produce useful results for some occupations in the other two zones. Table 23 summarizes the residuals and shows that out of the 11 years, the revised model produced better predictions for 7 years and the original model produced better predictions for 4 years. Furthermore, the revised model's performance is more consistent over the years, as the range of the residual is much smaller (-6.7%, 5.3%) compared to that under the original model (-11.8%, 9%).

Table 23. Prediction Residuals from Revised and Original Model (Zone A only)

FY	Actual reenlistment (%)	Prediction (%)		Residual (%)	
		Old model	New model	Old model	New model
1990	39.0	41.8	40	2.8	1.0
1991	40.8	40.7	39.2	-0.1	-1.7
1992	36.4	45.4	41.7	9.0	5.3
1993	47.0	45.8	42.8	-0.5	-4.1
1994	48.9	49.6	46.6	0.7	-2.3
1995	45.5	49.5	46	4.0	0.4
1996	46.2	49.9	45.8	3.8	-0.4
1997	54.4	45.9	52.6	-8.6	-1.9
1998	53.3	41.5	46.6	-11.8	-6.7
1999	52.1	49.4	58.1	-2.7	6.0
2000	55.7	50.1	58.2	-5.5	2.5

Since the unemployment rate is an important variable in the new model, we report the estimated coefficients for the largest 19 CMF and 20 MOS in Table 24 and Table 25, respectively. Again, we omitted the coefficient if the unemployment coefficient was negative. Additional estimation results are available upon request.

Table 24. Unemployment Coefficients of the Largest 19 CMF

	Zone A		Zone B		Zone C	
CMF	Estimate	SE	Estimate	SE	Estimate	SE
11	0.0.0889***	0.0138	0.0447**	0.0226	----------	--------
12	----------	---------	----------	--------	---------	--------
13	----------	---------	----------	--------	----------	--------
14	----------	---------	----------	--------	----------	----------
19	0.1065***	0.0235	----------	--------	----------	---------
31	0.0406**	0.02	0.0292	0.025	----------	-------
51	----------	--------	----------	--------	---------	--------
63	0.0121	0.0149	----------	-------	----------	--------
67	----------	--------	0.3127***	0.0316	----------	--------
71	0.0816***	0.0236	0.0456*	0.0259	----------	----------
76	0.1621***	0.0357	----------	-------	----------	--------
77	----------	--------	----------	--------	----------	----------
88	----------	--------	----------	---------	----------	----------
91	0.0151	0.0198	0.0724***	0.0247	----------	--------
92	0.2554***	0.0426	0.1065*	0.0559	0.139	0.1039
94	0.1439***	0.0346	----------	--------	----------	--------
95	0.0204	0.0284	0.214***	0.0313	0.0462	0.0535
96	---------	--------	0.1316**	0.0577	----------	--------
98	0.1546***	0.041	0.0199	0.0523	----------	--------

* $p < .10$, ** $p < .05$, *** $p < .01$

Table 25. Unemployment Coefficient of the Largest 20 MOS

	Zone A		Zone B		Zone C	
MOS	Estimate	SE	Estimate	SE	Estimate	SE
11B	0.1323***	0.0186	0.066**	0.0302	----------	-------
11C	0.0217	0.0394	0.1719**	0.072	----------	----------
11M	0.0788***	0.0283	----------	--------	---------	--------
12B	----------	--------	----------	--------	--------	--------
13B	0.0281	0.0249	0.0627	0.0394	-------	--------
19D	0.1855***	0.0392	----------	---------	---------	--------
19K	0.0748**	0.03	----------	--------	---------	--------
31U	0.2506***	0.0836	0.3701***	0.1122	0.2889	0.2373
52D	0.0339	0.0456	----------	--------	----------	--------
54B	----------	--------	----------	--------	---------	--------
63B	0.0102	0.0278	0.0204	0.0397	----------	--------
71L	0.2033***	0.0381	0.1029**	0.0411	----------	----------
76Y	0.145**	0.0598	----------	--------	----------	----------
77F	----------	---------	----------	--------	----------	----------
88M	----------	--------	----------	--------	----------	----------
91B	----------	--------	0.00632	0.0446	----------	----------
92A	0.3552***	0.0689	----------	---------	0.016	0.154-
92Y	----------	----------	0.2732***	0.1019	0.3388*	0.187
94B	0.1482***	0.0345	----------	--------	---------	--------
95B	0.0181	0.0293	0.2229***	0.0331	0.0326	0.5806

Based on the comparison of original and revised results, the revised results appear to be superior. The revised estimate will be incorporated into the SRB Management System model.

SRB Management System

The main objective of this analysis was to provide empirical evidence that the Army can use to manage its SRB program. The first step in doing so was to estimate the parameters of an Army retention model as reported above. These results provide us with robust measures of the responsiveness of reenlistment behavior to changes in military compensation.

Using these estimation results, we constructed a web-based policy analysis tool that explicitly emulates the ACOL calculations used in the analysis. This model allows users to project the effects of changes in alternative SRB plans on both the number of reenlistments and costs. Mackin and O'Brien (2005) provide a detailed description of the Army SRB Management System.

Summary

We have estimated the effects of reenlistment bonuses on Army reenlistments at the MOS level, covering almost 50% of all Soldiers at Zones A, B and C; and at the CMF level, covering about 90% of Soldiers at these zones. We have estimated both an original and a revised set of SRB policy models. The revised model accounted for the drawdown period and included an unemployment rate variable, which the original model did not. Based on a comparison of the results, the revised estimates are preferred. The results at both the MOS and CMF level for Zone A bonuses are positive, statistically significant, and of a magnitude that is both plausible and consistent with previous studies. The results for Zone B and C are also reasonable and much better than the results from the original model. In the revised model, the unemployment rate has a significant effect on reenlistment rates, in most cases, while this was not the case in the original estimates. The predictions using the revised estimates are more accurate, on average, than those from the original estimates. Still, for a small number of occupation groups, we were unable to obtain Zone B and C pay effects that were positive and significantly different from zero. The reason is probably the lack of variation in bonuses, especially at zone C.

Finally, the empirical results reported here are incorporated into the SRB Management System. This system, grounded in the empirically estimated behavioral responses of Soldiers to bonuses, has the potential for improving the management and the effectiveness of the SRB program.

References

Amemiya, T. (1981). "Qualitative Response Models: A Survey," *Journal of Economic Literature, 19*, 1483-1536.

Arguden, R. Y. (1986). *Personnel Management in the Military: Effects of Retirement Policies on Retention of Personnel* (R-3342-AF). Santa Monica, CA: RAND Corporation.

Cooke, T. W., Marcus, A. J. & Quester, A. O. (1992). *Personnel Tempo of Operations and Navy Enlisted Retention.* CNA Research Memorandum 91-50.

Enns, J. H., Nelson, G., & Warner, J. T. (1984). The Economics of Retention and Retirement: The Case of the U.S. Military. *Policy Sciences*, 17, 101-121.

Goldberg, M. S. (2001). *A Survey of Enlisted Retention: Models and Findings.* CNA Research Memorandum D0004085.A2.

Goldberg, M. S., & Warner, J. T. (1982). *Determinants of Navy Reenlistment and Extension Rates.* CNA Research Contribution 476.

Greene, W. H. (1990). *Econometric Analysis.* New York: Macmillan Publishing Company.

Hosek, J., & Peterson, C. (1985). *Reenlistment Bonuses and Retention Behavior.* Santa Monica, CA: RAND Corporation (R-3199-MIL).

Johnson, N. L., & Kotz , S. (1970). *Continuous Univariate Distributions*(Vol 1). Boston: Houghton Mifflin.

Maddala, G.S. (1983). *Limited-Dependent and Qualitative Variables in Econometrics.* New York: Cambridge University Press.

Mackin, P. C., Mackie, C. D., Darling, K. L, & Mairs, L. S. (1996). *U.S. Navy Enlisted Compensation and Retention Modeling.* Falls Church, VA: SAG Corporation.

Mackin, P., & O'Brien, K. (2005). *Army Selective Reenlistment Bonus Management System: Functional and User Documentation* (Study Note 2005-04). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Smith, D. A., Sylwester, S. D., & Villa, C. M. (1991). Army Reenlistment Models, in Curtis L. Gilroy, David K. Horne and D. Alton Smith (Eds), *Military Compensation and Personnel Retention: Models and Evidence.* Alexandria, VA: U. S. Army Research Institute for the Behavioral and Social Sciences.

Warner, J. T., & Goldberg, M. S. (1984). The Influence of Non-Pecuniary Factors on Labor Supply: The Case of Navy Enlisted Personnel. *Review of Economics and Statistics, 66.* 26-35.

Warner, J. T., & Pleeter, S. (2001). The Personal Discount Rate: Evidence from Military Downsizing Programs. *American Economic Review, 91*, 33-53.

APPENDIX A: CMF/MOS TABLE

CMF	Description	MOS	Description
11	Infantry	11B	INFANTRYMAN
		11C	INDIRECT FIRE INFANTRYMAN
		11H	HEAVY ANTIARMOR WEAPONS INFANTRYMAN (del 0209 / 0204-06)
		11M	MECHANIZED INFANTRYMAN (del 0209 / 0204-06)
		11Z	INFANTRY SENIOR SERGEANT
12	Combat Engineer	12B	COMBAT ENGINEER
		12C	BRIDGE CREWMEMBER
		12F	ENG TRK VEH CRMN (del 9610 / 9604-18)
		12Z	COMBAT ENGINEERING SENIOR SERGEANT
13	Field Artillery	13B	CANNON CREWMEMBER
		13C	TACTICAL AUTOMATED FIRE CONTROL SYSTEMS SPECIALIST
		13D	FIELD ARTILLERY AUTOMATED TACTICAL DATA SYSTEM SPECIALIST
		13E	CANNON FIRE DIRECTION SPECIALIST
		13F	FIRE SUPPORT SPECIALIST
		13M	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) CREWMEMBER
		13N	LANCE CREWMEMBER (del 9304)
		13P	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) OPERATIONAL FIRE DIRECTION SPECIALIST
		13R	FIELD ARTILLERY FIREFINDER RADAR OPERATOR
		13T	RPV CRMBR (del 9010)
		13W	FIELD ARTILLERY METEOROLOGICAL CREWMEMBER (add 0304 / 0104-07)
		13Z	FIELD ARTILLERY SENIOR SERGEANT (add 0304 / 0104-07)
		15E	PERSHING MSL CRMBR (del 9204)
		17B	FA RADAR CRMBR (del 9404)
		21G	PERSHING ELCT MAT SP (del 9204)
		82C	FIELD ARTILLERY SURVEYOR
		93F	FIELD ARTILLERY METEOROLOGICAL CREWMEMBER (del 0409 / 0104-07)
14	Air Defense Artillery	14D	HAWK MISSILE SYSTEM CREWMEMBER (RC) (del 0110 / 0010-01)
		14E	PATRIOT FIRE CONTROL ENHANCED OPERATOR/MAINTAINER
		14J	AIR DEFENSE COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INTELLIGENCE TACTICAL OPERATIONS CENTER ENHANCED OPERATOR/MAINTAINER
		14L	AN/TSQ-73 AIR DEFENSE ARTILLERY COMMAND AND CONTROL SYSTEM OPERATOR/ (del 0110 / 0010-01)
		14M	MAN PORTABLE AIR DEFENSE SYSTEM CREWMEMBER (RC)
		14R	BRADLEY LINEBACKER CREWMEMBER
		14S	AVENGER CREWMEMBER
		14T	PATRIOT LAUNCHING STATION ENHANCED OPERATOR/MAINTAINER
		14Z	AIR DEFENSE ARTILLERY SENIOR SERGEANT
		16D	HAWK MISSILE CRMBR (del 9504 / 9410)
		16E	HAWK FC CRMBR (del 9504 / 9410)
		16F	LIGHT AD ARTY CRMBR (del 9110)
		16J	FAAR OPERATOR (del 9204)
		16P	CHAPARRAL CRMBR (del 9804 / 9804-27)
		16R	VULCAN CRMBR (del 9704 / 9610-11)
		16S	MANPADS CREWMEMBER (del 9704 / 9610-11)
		16T	PATRIOT MSL CRMBR (del 9704 / 9610-11)
		16Z	ADA SENIOR SGT (del 9704 / 9610-11)
		23R	HAWK MISSILE SYSTEM MECHANIC (RC) (del 0110 / 0010-01)
		24N	CHAPARRAL SYS MECH (del 9804 / 9804-27)

CMF	Description	MOS	Description
15	Aviation	15B	AIRCRAFT POWERPLANT REPAIRER (add 0404 / 0204-44)
		15D	AIRCRAFT POWERTRAIN REPAIRER (add 0404 / 0204-44)
		15F	AIRCRAFT ELECTRICIAN (add 0404 / 0204-44)
		15G	AIRCRAFT STRUCTURAL REPAIRER (add 0404 / 0204-44)
		15H	AIRCRAFT PNEUDRAULICS REPAIRER (add 0404 / 0204-44)
		15J	OH-58D ARMAMENT/ELECTRICAL/AVIONICS SYSTEMS REPAIRER (add 0404 / 0204-44)
		15K	AIRCRAFT COMPONENTS REPAIR SUPERVISOR (add 0404 / 0204-44)
		15M	UH-1 HELICOPTER REPAIRER (add 0404 / 0204-44)
		15N	AVIONIC/MECHANIC (add 0404 / 0204-44)
		15P	AVIATION OPERATIONS SPECIALIST (add 0404 / 0204-44)
		15Q	AIR TRAFFIC CONTROL OPERATOR (add 0404 / 0204-44)
		15R	AH-64 ATTACK HELICOPTER REPAIRER (add 0404 / 0204-44)
		15S	OH-58D HELICOPTER REPAIRER (add 0404 / 0204-44)
		15T	UH-60 HELICOPTER REPAIRER (add 0404 / 0204-44)
		15U	CH-47 HELICOPTER REPAIRER (add 0404 / 0204-44)
		15V	OBSERVATION/SCOUT HELICOPTER REPAIRER (RC) (add 0404 / 0204-44)
		15X	AH-64A ARMAMENT/ELECTRICAL SYSTEMS REPAIRER (add 0404 / 0204-44)
		15Y	AH-64D ARMAMENT/ELECTRICAL/AVIONIC SYSTEMS REPAIRER (add 0404 / 0204-44)
		15Z	AIRCRAFT MAINTENANCE SENIOR SERGEANT (add 0404 / 0204-44)
		67G	UTILITY AIRPLANE REPAIRER) (RC)
		67Y	AH1 ATTACK HELICOPTER REPAIRER (RC)
		68J	AIRCRAFT ARMAMENT/MISSILE SYSTEMS REPAIRER (RC)
18	Special Forces	18B	SPECIAL FORCES WEAPONS SERGEANT
		18C	SPECIAL FORCES ENGINEER SERGEANT
		18D	SPECIAL FORCES MEDICAL SERGEANT
		18E	SPECIAL FORCES COMMUNICATIONS SERGEANT
		18F	SPECIAL FORCES ASSISTANT OPERATIONS AND INTELLIGENCE SERGEANT
		18Z	SPECIAL FORCES SENIOR SERGEANT
19	Cavalry	19D	CAVALRY SCOUT
		19E	M48-M60 ARMOR CREWMAN (del 9805 / 9804-11)
		19K	M1 ARMOR CREWMAN
		19Z	ARMOR SENIOR SERGEANT
21	Engineer	21V	TOPOGRAPHIC ENGINEER
		21X	TOPOGRATHIC ANALYST
		21Y	TOPOGRAPHIC SURVEYOR
23	Air Defense System Maintenance	24C	HAWK FIRING SEC MECH (del 9504 / 9410)
		24G	HAWK COORD CEN MECH (del 9504 / 9410)
		24M	VULCAN SYS MECHANIC (del 9704 / 9610-11)
		24R	HAWK MASTER MECH (del 9504 / 9410)
		24T	PATRIOT OP SYS MECH (del 9704 / 9610-11)
		25L	AN TSQ-73 OP/MAINT (del 9704 / 9610-11)
25	Visual Information	25M	MULTIMEDIA ILLUSTRATOR
		25P	VI/AUDIO DOC SYS SP (del 9404)
		25Q	GRAPHICS DOC SP (del 9404)
		25R	VISUAL INFORMATION EQUIPMENT OPERATOR-MAINTAINER
		25S	STILL DOC SP (del 9404)
		25V	COMBAT DOCUMENTATION/PRODUCTION SPECIALIST
		25Z	VISUAL INFORMATION OPERATIONS CHIEF

CMF	Description	MOS	Description
27	Paralegal and Missile Maintenance	21L	PERSHING ELCT REP (del 9104)
		27B	LCSS TEST SPECIALIST (del 9504)
		27D	PARALEGAL SPECIALIST
		27J	HAWK FME PAR RPR (del 9504)
		27L	LANCE SYS REPAIRER (del 9410)
		27N	FAAR REPAIRER (del 9204)
		27V	HAWK MAINT CHIEF (del 9404)
		46N	PERSH ELEC-MECH REP (del 9104)
31	Signal Operators	31C	RADIO OPERATOR-MAINTAINER
		31D	MSE XMSN SYS OP (del 9504)
		31F	NETWORK SWITCHING SYSTEMS OPERATOR-MAINTAINER
		31G	TAC COMM CH (del 9304)
		31K	COMBAT SIGNALER (del 9304)
		31L	CABLE SYSTEMS INSTALLER-MAINTAINER
		31M	MCHAN XMSN SYS OP (del 9504 / 9410)
		31N	COMM SYS/CKT CONTR (del 9404)
		31P	MICROWAVE SYSTEMS OPERATOR-MAINTAINER
		31Q	TACSAT MW SYS OP (del 9104)
		31R	MULTICHANNEL TRANSMISSION SYSTEMS OPERATOR-MAINTAINER
		31S	SATELLITE COMMUNICATION SYSTEMS OPERATOR-MAINTAINER
		31T	SATELLITE/MICROWAVE SYSTEMS CHIEF
		31U	SIGNAL SUPPORT SYSTEMS SPECIALIST
		31V	UL COMM MAINT (del 9304)
		31W	TELECOMMUNICATIONS OPERATIONS CHIEF
		31Y	TELECOMM SYS SUPV (del 9504 / 9410)
		31Z	SENIOR SIGNAL SERGEANT
		36L	AU SW SYS OPR MAINT (del 9504 / 9410)
		36M	SWITCHING SYS OP (del 9204)
		72E	TAC TEL CEN OP (del 9010)
		72G	AUTO DATA TELECOMM OP (del 9010)
33	Electronic Warfare Maintenance	33M	EW/I STRAT C/C REP (del 9104)
		33P	EW I RCVR EQUIP REP (del 9010)
		33Q	EW I PS EQUIP REP (del 9010)
		33R	EW/I AVN SYS REP (del 9804 / 9804-11)
		33T	EW/I TAC SYS REP (del 9804 / 9804-11)
		33V	EW/I AER SNSR REP (del 9310)
		33W	MILITARY INTELLIGENCE SYSTEMS MAINTAINER/INTEGRATOR
		33Y	STRAT SYS REP (del 9804 / 9804-11)
		33Z	EW/I SYS MAINT SUPV (del 9804 / 9804-11)

CMF	Description	MOS	Description
		24H	HAWK FIRE CON REP (del 9910 / 9904-23)
		24K	HAWK CW RDR REP (del 9910 / 9904-23)
		27E	LAND COMBAT ELECTRONIC MISSILE SYSTEM REPAIRER (del 0509 / 0204-28)
		27F	VULCAN REPAIRER (del 9510 / 95041)
		27G	CHAPARRAL AND REDEYE REPAIRER
		27H	HAWK FME/FS REP (del 9910 / 9904-23)
		27K	HAWK FC/CW REP (del 9910 / 9904-23)
		27M	MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) REPAIRER (del 0509 / 0204-28)
		27T	AVENGER SYSTEM REPAIRER (del 0509 / 0204-28)
		27X	PATRIOT SYSTEM REPAIRER (del 0509 / 0204-28)
		27Z	MISSILE SYSTEMS MAINTENANCE CHIEF (del 0509 / 0204-27)
		35A	LAND COMBAT ELECTRONIC MISSILE SYSTEM REPAIRER (add 0404 / 0204-28)
		35B	LCSS TEST SPC (add 0404 / 0204-28)
		35C	SURV RDR REP (del 0004 / 0004-11)
		35D	AIR TRAFFIC CONTROL EQUIPMENT REPAIRER
		35E	RADIO AND COMMUNICATIONS SECURITY (COMSEC) REPAIRER
35	Electronic Maintenance and Calibration	35F	SPECIAL ELECTRONIC DEVICES REPAIRER
		35H	TEST, MEASUREMENT, AND DIAGNOSTIC EQUIPMENT (TMDE) MAINTENANCE SUPPORT SPECIALIST
		35J	COMPUTER/AUTOMATION SYSTEM REPAIRER (del 0509 / 0204-42)
		35K	APACHE ATTACK HELICOPTER SYSTEMS REPAIRER (add 0404 / 0204-28)
		35L	AVIONIC COMMUNICATIONS EQUIPMENT REPAIRER (add 0404 / 0204-28)
		35M	RADAR REPAIRER
		35N	WIRE SYSTEMS EQUIPMENT REPAIRER (del 0509 / 0204-42)
		35P	MULTIPLE LAUNCH ROCKET SYSTEM REPAIRER (add 0404 / 0204-28A)
		35Q	AVIONIC FLT SYS REP (del 9910 / 9904-21)
		35R	AVIONIC SYSTEM REPAIRER
		35S	PATRIOT SYSTEM REPAIRER (add 0404 / 0204-28)
		35T	AVENGER SYSTEM REPAIRER (add 0404 / 0204-28)
		35V	ELECTRONIC AND MISSILE SYSTEMS MAINTENANCE CHIEF (add 0404 / 0204-27)
		35W	ELECTRONIC MAINTENANCE CHIEF
		35Y	INTEGRATED FAMILY OF TEST EQUIPMENT (IFTE) OPERATOR AND MAINTAINER
		35Z	SENIOR ELECTRONIC MAINTENANCE CHIEF
		39B	AUTOMATIC TEST EQUIPMENT OPERATOR AND MAINTAINER (del 0509 / 0204-28)
37	Psychological Operations	37F	PSYCHOLOGICAL OPERATIONS SPECIALIST
38	Civil Affairs	38A	CIVIL AFFAIRS SPECIALIST
44	Financial Management	44C	FINANCIAL MANAGEMENT TECHNICIAN (add 0404 / 0204-38)
		46Q	JOURNALIST (add 0404 / 0204-38)
46	Public Affairs	46R	BROADCAST JOURNALIST
		46Z	PUBLIC AFFAIRS CHIEF

CMF	Description	MOS	Description
		00B	DIVER
		51B	CARPENTRY AND MASONRY SPECIALIST
		51G	MATERIALS QUALITY SP (del 9404)
		51H	CONSTRUCTION ENGINEERING SUPERVISOR
		51K	PLUMBER
		51M	FIREFIGHTER
		51R	INTERIOR ELECTRICIAN
		51T	TECHNICAL ENGINEER
		51Z	GENERAL ENGINEERING SUPERVISOR
51	General Engineering	52E	PRIME POWER PDN SP (del 9104)
		52G	TRANSMISSION AND DISTRIBUTION SPECIALIST (RC)
		62E	HEAVY CONSTRUCTION EQUIPMENT OPERATOR
		62F	CRANE OPERATOR
		62G	QUARRYING SPECIALIST (RC)
		62H	CONCRETE AND ASPHALT EQUIPMENT OPERATOR
		62J	GENERAL CONSTRUCTION EQUIPMENT OPERATOR
		62N	CONSTRUCTION EQUIPMENT SUPERVISOR
		81B	TECHNICAL DRAFTING SP (del 9404)
		82B	CONSTRUCTION SURVEYOR (del 9404)
54	Chemical	54B	CHEMICAL OPERATIONS SPECIALIST
		55B	AMMUNITION SPECIALIST (del 0509 / 0204-41)
		55D	EXPLOSIVE ORDNANCE DISPOSAL SPECIALIST (del 0509 / 0204-41)
55	Ammunition	55G	NUC WPM SPEC (del 9410)
		55R	AMMO STK CTL ACTG SP (del 9304)
		55X	AMMUNITION INSPECTOR (del 9304)
		55Z	AMMUNITION SUPERVISOR (del 9604)
56	Religious Support	56M	CHAPLAIN ASSISTANT

CMF	Description	MOS	Description
		41C	FC INSTRUMENT REP (del 9204)
		44B	METAL WORKER
		44E	MACHINIST
		45B	SMALL ARMS/ARTILLERY REPAIRER
		45D	SELF-PROPELLED FIELD ARTILLERY TURRET MECHANIC (del 0509 / 0204-40)
		45E	M1 ABRAMS TANK TURRET MECHANIC (del 0509 / 0204-31)
		45G	FIRE CONTROL REPAIRER
		45K	ARMAMENT REPAIRER
		45L	ARTILLERY REPAIRER (del 9204)
		45N	M60A1/A3 TANK TURRET MECHANIC (RC) (del 0409 / 0104-14)
		45T	BRADLEY FIGHTING VEHICLE SYSTEM TURRET MECHANIC (del 0509 / 0204-31)
		45Z	ARMT FC MNT SUPV (del 9204)
		52C	UTILITIES EQUIPMENT REPAIRER
		52D	POWER-GENERATION EQUIPMENT REPAIRER
63	Mechanical Maintenance	52F	TURBINE ENG DRV REP (del 9804 / 9804-31)
		52X	SPECIAL PURPOSE EQUIPMENT REPAIRER
		62B	CONSTRUCTION EQUIPMENT REPAIRER
		63A	M1 ABRAMS TANK SYSTEM MAINTAINER
		63B	LIGHT-WHEEL VEHICLE MECHANIC
		63D	ARTILLERY MECHANIC
		63E	M1 ABRAMS TANK SYSTEM MECHANIC (del 0509 / 0204-31)
		63G	FUEL AND ELECTRICAL SYSTEMS REPAIRER (del 0509 / 0204-43)
		63H	TRACK VEHICLE REPAIRER
		63J	QUARTERMASTER AND CHEMICAL EQUIPMENT REPAIRER
		63M	BRADLEY FIGHTING VEHICLE SYSTEM MAINTAINER
		63N	M60A1/A3 TANK SYSTEM MECHANIC (RC) (del 0309 / 0104-14)
		63S	HEAVY-WHEEL VEHICLE MECHANIC (del 0509 / 0204-43)
		63T	BRADLEY FIGHTING VEHICLE SYSTEM MECHANIC (del 0509 / 0204-31)
		63W	WHEEL VEHICLE REPAIRER (del 0509 / 0204-43)
		63X	VEHICLE MAINTENANCE S (add 0404 / 0204-43)
		63Y	TRACK VEHICLE MECHANIC (del 0509 / 0204-43)
		63Z	MECHANICAL MAINTENANCE SUPERVISOR

CMF	Description	MOS	Description
67	Aircraft Maintenance	67A	GEN AIRCRAFT REP (del 9310)
		67B	CERT GEN AIRCRAFT REP (del 9310)
		67G	UTILITY AIRPLANE REPAIRER) (RC)
		67H	OBSN AIRPLANE REP (del 9610 / 9604-13)
		67N	UH-1 HELICOPTER REPAIRER (del 0509 / 0204-44)
		67R	AH-64 ATTACK HELICOPTER REPAIRER (del 0509 / 0204-44)
		67S	OH-58D HELICOPTER REPAIRER (del 0509 / 0204-44)
		67T	UH-60 HELICOPTER REPAIRER (del 0509 / 0204-44)
		67U	CH-47 HELICOPTER REPAIRER (del 0509 / 0204-44)
		67V	OBSERVATION/SCOUT HELICOPTER REPAIRER (RC) (del 0509 / 0204-44)
		67X	HEAVY LIFT HEL REP (del 9404)
		67Y	AH1 ATTACK HELICOPTER REPAIRER (RC)
		67Z	AIRCRAFT MAINTENANCE SENIOR SERGEANT (del 0509 / 0204-44)
		68B	AIRCRAFT POWERPLANT REPAIRER (del 0509 / 0204-44)
		68D	AIRCRAFT POWERTRAIN REPAIRER (del 0509 / 0204-44)
		68F	AIRCRAFT ELECTRICIAN (del 0509 / 0204-44)
		68G	AIRCRAFT STRUCTURAL REPAIRER (del 0509 / 0204-44)
		68H	AIRCRAFT PNEUDRAULICS REPAIRER (del 0509 / 0204-44)
		68J	AIRCRAFT ARMAMENT/MISSILE SYSTEMS REPAIRER (RC)
		68K	AIRCRAFT COMPONENTS REPAIR SUPERVISOR (del 0509 / 0204-44)
		68L	AVIONIC COMM EQ REP (del 9604 / 06)
		68N	AVIONIC/MECHANIC (del 0509 / 0204-44)
		68P	AVIONIC MAINT SUPV (del 9904 / 9704-02)
		68Q	AVIONIC FLT SYS REP (del 9604 / 06)
		68R	AVIONIC RADAR REP (del 9604 / 06)
		68S	OH-58D ARMAMENT/ELECTRICAL/AVIONICS SYSTEMS REPAIRER (del 0509 / 0204-44)
		68X	AH-64A ARMAMENT/ELECTRICAL SYSTEMS REPAIRER (del 0509 / 0204-44)
		68Y	AH-64D ARMAMENT/ELECTRICAL/AVIONIC SYSTEMS REPAIRER (del 0509 / 0204-44)
71	Administration	00U	EQUAL OPPORTUNITY NCO (del 0104 / 0104-05)
		71C	EXEC ADMIN ASST (del 9604 / 03)
		71D	LEGAL SPECIALIST (del 0110 / 0010-21)
		71E	COURT REPORTER (del 9410)
		71L	ADMINISTRATIVE SPECIALIST
		71M	CHAPLAIN ASSISTANT (del 0110 / 0010-19)
		73C	FINANCE SPECIALIST (del 0509 / 0204-38)
		73D	ACCOUNTING SPECIALIST (del 0509 / 0204-38)
		73Z	FINANCE SENIOR SERGEANT (del 0509 / 0204-38)
		75B	PERSONNEL ADMINISTRATION SPECIALIST
		75C	PERSONNEL MGT SP (del 9604 / 10)
		75D	PERSONNEL RECORDS SP (del 9604 / 10)
		75E	PERSONNEL ACTIONS SP (del 9604 / 10)
		75F	PERSONNEL INFORMATION SYSTEM MANAGEMENT SPECIALIST
		75H	PERSONNEL SERVICES SPECIALIST
		75Z	PERSONNEL SERGEANT (del 9604)
74	Record Information Specialist	74B	INFORMATION SYSTEMS OPERATOR-ANALYST
		74C	TELECOMMUNICATIONS OPERATOR-MAINTAINER
		74D	INFO SYS OPR (del 9504)
		74F	SOFTWARE ANALYST (del 9504)
		74G	TELECOM CMPT OP-MNT (del 0309 / 0004-12)
		74Z	INFORMATION SYSTEMS CHIEF
77	Petroleum and Water	77F	PETROLEUM SUPPLY SPECIALIST
		77L	PETROLEUM LABORATORY SPECIALIST
		77W	WATER TREATMENT SPECIALIST

CMF	Description	MOS	Description
79	Recruitment	00E	RECRUITER (RC) (del 9510)
		00R	RECRUITER RET NCO (del 9510)
		79D	RETN NCO ARNG/USAR (del 9510 / 22)
		79R	RECRUITER
		79S	CAREER COUNSELOR
		79T	RECRUITING AND RETENTION NCO (ARMY NATIONAL GUARD OF THE UNITED STATES)
		79V	RETENTION AND TRANSITION NCO, USAR
81	Topographic Engineering	81C	CARTOGRAPHER (del 9704 / 9610-16)
		81L	LITHOGRAPHER
		81Q	TERRAIN ANALYST (del 9704 / 9610-16)
		81T	TOPOGRAPHIC ANALYST
		81Z	TOPOGRAPHIC ENGINEERING SUPERVISOR
		82D	TOPOGRAPHIC SURVEYOR
88	Transportation	83E	PHOTO AND LAYOUT SP (del 9510 / 01)
		83F	PRTG AND BIND SP (del 9510 / 01)
		88H	CARGO SPECIALIST
		88K	WATERCRAFT OPERATOR
		88L	WATERCRAFT ENGINEER
		88M	MOTOR TRANSPORT OPERATOR
		88N	TRANSPORTATION MANAGEMENT COORDINATOR
		88P	RAILWAY EQUIPMENT REPAIRER (RC)
		88Q	RAILWAY CAR REPAIRER (del 9404)
		88R	AIRBRAKE REPAIRER (del 9404)
		88S	LOCOMOTIVE ELEC (del 9404)
		88T	RAILWAY SECTION REPAIRER (RC)
		88U	RAILWAY OPERATIONS CREWMEMBER (RC)
		88V	TRAIN CREWMEMBER (del 9404)
		88W	RAILWAY MOV COORD (del 9404)
		88X	RAILWAY SENIOR SERGEANT (RC) (del 0509 / 0204-21)
		88Y	MARINE SENIOR SGT (del 9510 / 95046)
		88Z	TRANSPORTATION SENIOR SERGEANT
89	Ammunition	89B	AMMUNITION SPECIALIST (add 0404 / 0204-41)
		89D	EXPLOSIVE ORDNANCE DISPOSAL SPECIALIST (add 0404 / 0204-41)

CMF	Description	MOS	Description
		01H	BIO SCIENCES ASST (add 0404 / 0204-41)
		35G	MED EQUIP REP UL (del 9410)
		35U	MED EQUIP REP ADV (del 9410)
		42C	ORTHOTIC SPECIALIST (del 9410)
		42D	DENTAL LABORATORY SP (del 9410)
		42E	OPTICAL LABORATORY SPECIALIST (del 0110 / 0004-05)
		71G	PATIENT ADMIN SPECIALIST (del 0110 / 0004-05)
		76J	MEDICAL SUPPLY SPECIALIST (del 0110 / 9904-15)
		91A	MEDICAL EQUIPMENT REPAIRER
		91B	MEDICAL SPECIALIST (del 0110 / 0004-05)
		91D	OPERATING ROOM SPECIALIST
		91E	DENTAL SPECIALIST
		91F	PSYCHIATRIC SP (del 9610 / 9604-14)
		91G	PATIENT ADMINISTRATION SPECIALIST
		91H	OPTICAL LABORATORY SPECIALIST
		91J	MEDICAL LOGISTICS SPECIALIST
91	Medical	91K	MEDICAL LABORATORY SPECIALIST
		91L	OCC THERAPY SP (del 9410 / 9410)
		91M	HOSPITAL FOOD SERVICE SPECIALIST
		91N	CARDIAC SPECIALIST (del 9504)
		91P	RADIOLOGY SPECIALIST
		91Q	PHARMACY SPECIALIST
		91R	VETERINARY FOOD INSPECTION SPECIALIST
		91S	PREVENTIVE MEDICINE SPECIALIST
		91T	ANIMAL CARE SPECIALIST
		91U	ENT SPECIALIST (del 9410 / 9410)
		91V	RESPIRATORY SPECIALIST
		91W	HEALTH CARE SPECIALIST
		91X	MENTAL HEALTH SPECIALIST
		91Y	EYE SPECIALIST (del 9410 / 9410)
		91Z	CHIEF MEDICAL NCO
		92B	MEDICAL LAB SP (del 9410 / 9410)
		92E	CYTOLOGY SPECIALIST (del 9410 / 9410)
		94F	HOSP FOOD SERVICE SP (del 9010)
		43E	PARACHUTE RIGGER (del 9510 / 17)
		43M	FABRIC REPAIR SPECIALIST (del 0110 / 0010-13A)
		57E	LAUNDRY AND SHOWER SPECIALIST (del 0110 / 0010-13A)
		57F	MORTUARY AFFAIRS SPEC (del 9510 / 17)
		92A	AUTOMATED LOGISTICAL SPECIALIST
92	Supply and Services	92G	FOOD SERVICE OPERATIONS
		92M	MORTUARY AFFAIRS SPECIALIST
		92R	PARACHUTE RIGGER
		92S	LAUNDRY AND TEXTILE SPECIALIST
		92Y	UNIT SUPPLY SPECIALIST
		92Z	SENIOR NONCOMMISSIONED LOGISTICIAN
		93B	AEROSCOUT OBS (del 9804 / 9804-21)
93	Aviation Operations	93C	AIR TRAFFIC CONTROL (ATC) OPERATOR (del 0509 / 0204-44)
		93D	ATC EQUIP REP (del 9604 / 06)
		93P	AVIATION OPERATIONS SPECIALIST (del 0509 / 0204-44)
94	Food Service	94B	FOOD SERVICE SP (del 9510 / 95041)
		95B	MILITARY POLICE
95	Military Police	95C	INTERNMENT/RESETTLEMENT SPECIALIST
		95D	CID SPECIAL AGENT

CMF	Description	MOS	Description
96	Military Intelligence	96B	INTELLIGENCE ANALYST
		96D	IMAGERY ANALYST
		96F	PSYOP SPEC (del 9010)
		96H	COMMON GROUND STATION (CGS) OPERATOR
		96R	GROUND SURVEILLANCE SYSTEMS OPERATOR
		96U	UNMANNED AERIAL VEHICLE OPERATOR
		96Z	INTELLIGENCE SENIOR SERGEANT
		97B	COUNTER INTELLIGENCE AGENT
		97E	HUMAN INTELLIGENCE COLLECTOR
		97G	MDCI ANALYST (del 9804 / 9804-11)
		97L	TRANSLATOR/INTERPRETER (RC)
		97Z	COUNTER INTELLIGENCE/HUMAN INTELLIGENCE SENIOR SERGEANT
97	Bands	02A	ARMY BANDPERSON (add 0404 / 0204-18)
		02B	CORNET OR TRUMPET PLAYER (add 0404 / 0204-18)
		02C	EUPHONIUM PLAYER (del 0509 / 0204-18)
		02D	FRENCH HORN PLAYER (del 0509 / 0204-18)
		02E	TROMBONE PLAYER (del 0509 / 0204-18)
		02F	TUBA PLAYER (del 0509 / 0204-18)
		02G	FLUTE/PICCOLO PLAYER (del 0509 / 0204-18)
		02H	OBOE PLAYER (del 0509 / 0204-18)
		02J	CLARINET PLAYER (del 0509 / 0204-18)
		02K	BASSOON PLAYER (del 0509 / 0204-18)
		02L	SAXOPHONE PLAYER (del 0509 / 0204-18)
		02M	PERCUSSION PLAYER (del 0509 / 0204-18)
		02N	KEYBOARD PLAYER (del 0509 / 0204-18)
		02S	SPECIAL BAND MEMBER (del 9804 / 9804-20)
		02T	GUITAR PLAYER (del 0509 / 0204-18)
		02U	ELECTRIC BASS PLAYER (del 0509 / 0204-18)
		02Z	BANDS SENIOR SERGEANT (del 0509 / 0204-18)
98	Signals Intelligence/ Electronic War Ops	98C	SIGNALS INTELLIGENCE ANALYST
		98D	EMITTER LOC/IDENT (del 9804 / 9804-11)
		98G	CRYPTOLOGIC LINGUIST
		98H	COMMUNICATIONS INTERCEPTOR/LOCATOR
		98J	ELECTRONIC INTELLIGENCE INTERCEPTOR/ANALYST
		98K	SIGNAL COLLECTION/IDENTIFICATION ANALYST
		98Z	SIGNALS INTELLIGENCE (ELECTRONIC WARFARE) / SENIOR SERGEANT / CHIEF

APPENDIX B: ANALYSIS DATA SET CONSTRUCTION

Creation of the analysis data set required a large amount of data manipulation. This discussion details the process by which we created the estimation data set in the hopes that certain portions may be automated or streamlined in future analyses.

The analysis data set was constructed from the following data sources:

- Annual Enlisted Master File (EMF) extracts for end of September 1989 through September 2000
- Annual extracts of the Loss File covering Fiscal Years 1990 through 2000
- Basic Pay and Regular Military Compensation tables for Fiscal Years 1990 through 2000
- Selective Reenlistment Bonus (SRB) history file for Fiscal Years 1990 through 2000[22]
- Historical economic data, including national unemployment rates, Consumer Price Index (CPI) inflation rates,and Current Population Survey (CPS) earnings indexes
- A sample of CPS data from 1984 through 1998, used to estimate civilian earnings

The data were used to identify eligible individuals in each fiscal year, characterize their behavior (reenlist/leave) and construct or extract the necessary explanatory variables.

To identify eligible Soldiers, we first established the period of analysis (FY1990-FY2000) and the analysis interval (a single fiscal year). We wanted to identify all Soldiers eligible to make a stay/leave decision within each analysis interval. To do so, we had to understand the relevant reenlistment rules, which changed over the period of analysis. For FY1990 through FY1997, Soldiers could reenlist up to 8 months prior to Expiration of Term of Service (ETS); after 1997, the reenlistment window expanded to 12 months prior to ETS. This policy resulted in Soldiers reenlisting in the fiscal year prior to the one in which their ETS dates fell. To look at reenlistment decisions made in FY1990, for example, we would look at any Soldiers (observed in the end-September 1989 EMF extract) who had an ETS date of 1 October 1989 through 31 May 1991.

Once we had a pool of eligible Soldiers, we tracked their behavior across the analysis interval (fiscal year). For each Soldier, there were up to four possible outcomes:

- *Reenlistment* — By the last day of the fiscal year, we observed a new date of last enlistment (DATLA) falling in the analysis interval.
- *Voluntary Loss* — We observed a valid loss code with a loss date within 90 days of ETS for the Soldier in the analysis interval
- *Censored Loss* — Soldier was a loss to the Army, but for involuntary reasons (e.g., death or disability). Soldiers who left more than 90 days prior to ETS were also considered involuntary losses. These records were censored from the analysis data set.
- *No Action* — Some Soldiers whose ETS dates fell in the subsequent analysis period would take no action (would remain eligible for another analysis interval).

[22] We were not able to find SRB historical data in electronic format for the Army. We were forced to construct this history file using hard copies of messages setting SRB plans. Future analyses would be greatly simplified if this historical file were maintained.

Soldiers who reenlisted in the fiscal year prior to their ETS fiscal years were characterized as making decisions in their ETS fiscal years, rather than in the year in which their reenlistments were observed. However, we recorded both the fiscal year to which we attributed the decision and the fiscal year in which the transaction occurred.

As each eligible decision was identified and characterized, we wrote a record containing the eligibility year, the decision year, the outcome and several variables from the EMF or Loss files that would be used either as explanatory variables or in the construction of other variables (e.g., the Annualized Cost of Leaving [ACOL] value). For example, we included personal attributes like marital status, number of dependents, and age (observed at the beginning of the analysis interval). Service characteristics like paygrade and years of service (YOS; calculated from Basic Active Service Date) are also included.

The next step in the data set construction was to assign SRB levels to each decision record. To do so, we compared each Soldier's characteristics — SRB zone, period of eligibility, and skill identifiers like Primary Military Occupational Specialty (PMOS), Additional Skill Identifier (ASI), Skill Qualification Identifier (SQI), and Language Identification Code (LIC) — to the SRB levels in the history file. We captured all SRB levels for which the individual could have reenlisted from the beginning of his or her eligibility window (8 to 12 months prior to ETS) until the date of the observed outcome (loss or reenlistment). A Soldier may have faced multiple SRB offers because of skill combinations and/or changes in the plan across the period of eligibility. We assigned the largest SRB award level offered to each Soldier.

Targeted SRBs (which vary by location) presented another challenge. It was not possible to identify Soldiers who were separately eligible for targeted SRBs. In practice, any Soldier in a qualifying skill could choose one of the location premiums if it was available at the time of reenlistment. We incorporated the targeted SRB amounts into a weighted average for the skill. Weights were based on the proportion of Soldiers in a given skill who were assigned to the location with a targeted SRB. Additionally, we included an additional dummy variable equal to 1 when a Soldier was eligible for a targeted SRB.

The final step in constructing the estimation data set was calculation of the ACOL variable. We wrote a program that read variables describing the eligible Soldier and retrieved pay and civilian earnings information from the other data sources. The program then calculated the ACOL value at each possible horizon (stay until current YOS + 1, current YOS + 2,...,YOS 30) and saved the value at which the ACOL was a maximum. The program also recorded the horizon associated with the maximum ACOL value, although this variable was not used directly in the estimation.

Each record included ACOL values calculated using a range of personal discount rates from 10% to 20% in increments of 2 percentage points (a total of six ACOL values). We recorded the horizon for each; the ACOL horizon usually dropped as the discount rate rose.

Table B-1, Table B-2, and Table B-3 display the layouts of the EMF extracts, the loss file extracts, and the SRB history file, respectively.

Table B1. EMF Extract Layout

Variable Name	Type	Size
SSN	Text	9
Gender	Text	1
COMPT	Text	1
RSCD	Text	1
Race	Text	1
DOB	Text	6
TOS	Text	1
ETSD	Text	6
BASD	Text	4
TypLA	Text	2
DatLA	Text	4
Paygrade	Long Integer	4
Elig	Text	2
AFQT	Long Integer	4
CivEduc	Text	1
DMOS	Text	5
PMOS	Text	5
BEPD	Text	4
DOR	Text	4
LIC	Text	2
ASI	Text	2
NSNUP	Long Integer	4
CMF	Text	2
MarStat	Text	1
NumDep	Long Integer	4
SRBMOS	Text	3
SRBGrade	Text	1
UIC	Text	6
ASI2	Text	2
ASI3	Text	2
REDCAT	Text	1
ASI4	Text	2
SRBMult	Text	3
BonDes	Text	3
PMLOffDate	Text	6
ReqPML	Text	3
ReqDate	Text	6
DecDate	Text	6
SQI	Text	1

Table B2. Loss File Layout

Variable Name	Type	Size
SSN	Text	9
TTRAN	Text	2
DTTRAN	Text	6
BINDO	Text	1
BMOSO	Text	3
NREUP	Long Integer	4
SPD	Text	3
ETSD	Text	6
ELIGR	Text	2
REMULT	Text	1
LIC	Text	2

Table B3. SRB History File Layout

Variable Name	Type	Size
MOS	Text	3
ASI	Text	2
SQI	Text	1
LIC	Text	2
LOCATION	Text	50
BEAR	Boolean	1
ZONEAMULT	Text	3
ZONEBMULT	Text	3
ZONECMULT	Text	3
STARTDATE	Date	4
PAYGRADE	Text	1
LOCATIONWEIGHT	Long Integer	4

APPENDIX C: ECONOMETRIC MODEL DERIVATION

The model's key assumption is that the random errors (γ_I) are distributed independently according to the log Weibull (type I extreme value) distribution. That is, $\gamma_I = \theta_i + \theta_o \gamma_I^*$, $\theta_o > \theta_I$, and γ_I^* are independently distributed:

$$G(\lambda_i^*) = e^{-e^{-(\lambda_i^*)}}.$$

The distribution's density is $e^{-\lambda_i^*} * e^{-e^{-(\lambda_i^*)}}$, with a unique mode at zero, a mean of about 0.577 and a variance of $\frac{\pi^2}{6}$. Thus, $E(\gamma_I) = \theta_i + 0.577 * \theta_o$ and $var(\gamma_I) = \theta_o^2 * \left[\frac{\pi^2}{6}\right]$.[23]

Dividing by a common factor (θ_o) does not affect order of preference among choices. The results of the decision rule remain the same with the normalized utilities:

$$V_{in} = \theta_i^* + \alpha_i^* Z_n + \beta M_{in} + \gamma_i^*,$$

where $\theta_i^* = \frac{\theta_i}{\theta_o}, \alpha_i^* = \frac{\alpha_i}{\theta_0}, \text{and} \beta = \frac{1}{\theta_0}$.

The distributional assumptions regarding γ_I^* imply the following probability:

$$P_{in} = \frac{e^{(\theta_i^* + \alpha_i^* Z_n + \beta M_{in})}}{\sum_{j=1}^{2} e^{(\theta_j^* + \alpha_j^* Z_n + \beta M_{jn})}}.$$

If the leave option is the "benchmark" choice, the individual probabilities may be expressed in the ACOL framework.[24] For example,

$$P_{Rn} = \frac{e^{(\theta^*_R + \alpha^*_R Z_n + \beta M_R)}}{e^{(\theta^*_L + \alpha^*_L Z_n + \beta C)} + e^{(\theta^*_R + \alpha^*_R Z_n + \beta M_R)}}$$

Multiplying by the unit expression

$$\left[\frac{e^{-(\theta_L^* + \alpha_L^* Z_n + \beta C)}}{e^{-(\theta_L^* + \alpha_L^* Z_n + \beta C)}}\right],$$

and simplifying,

[23] Johnson and Kotz (1970), p. 272.
[24] Amemiya (1981), pp. 1511, 1516.

$$P_{Rn} = \frac{e^{\left[(\theta_R^* - \theta_L^*) + (\alpha_R^* - \alpha_L^*)Z_n + \beta(M_R - C)\right]}}{1 + e^{\left[(\theta_R^* - \theta_L^*) + (\alpha_R^* - \alpha_L^*)Z_n + \beta(M_R - C)\right]}}.$$

By similar transformation, one can derive P_{Ln}:

$$P_{Ln} = \frac{1}{1 + e^{\left[(\theta_R^* - \theta_L^*) + (\alpha_R^* - \alpha_L^*)Z_n + \beta(M_R - C)\right]}}.$$

Maximum likelihood techniques are used to estimate models in which the dependent variable (stay/leave) takes on a discrete number of values. The objective with maximum likelihood estimation is to arrive at parameter estimates that make it most likely that the observed pattern of decisions would have occurred.

First, make the following assumptions (Maddala 1983, pp. 73-75):

1. The data contain *N* individual observations.
2. *j* denotes the individual's choice (reenlist = 1, leave = 2).
3. X_{tj} represents the choice characteristic (in this case, the income variable) for the t^{th} individual's j^{th} choice.
4. β is the coefficient on *X*.
5. Z_t is a *p x 1* vector of personal attributes for individual *t*.
6. α_j is the *p x 1* vector of coefficients on *Z* associated with the j^{th} choice, where *p* is the number of explanatory variables in *Z*.

Next, define Y_{tj} as an observed variable equal to one if individual *t* makes choice *j*, and equal to 0 otherwise. Further, P_{tj} is the underlying (unobserved) probability that *t* will choose *j*. Normalize the model by defining

$$X_{tj^*} = X_{tj} - X_{tL} \text{ and}$$

$$\alpha_{j^*} = \alpha_j - \alpha_L.$$

Thus, X_{tL}^* and α_L^* both are equal to zero.

Finally, define

$$\theta = \begin{bmatrix} \beta \\ \alpha \end{bmatrix}_{(1+px1)} \text{ and}$$

$$W_{tR} = \begin{bmatrix} X_{tR^*} \\ Z_{tR^*} \end{bmatrix}_{(1+2px1)}.$$

This can be restated

$$P_{tj} = \frac{e^{\theta' W_{tj}}}{1 + e^{\theta' W_{tR}}}.$$

Note that the condition $\alpha_L^* = X_{tL}^* = 0$ implies that $\theta' W_{tL} = 0$. Therefore, $e^{\theta' W_{tL}} = e^0 = 1$.

The likelihood function takes the form

$$L = \prod_{t=1}^{N} \prod_{j=1}^{2} P_{tj}^{Y_{tj}} .$$

A logarithmic specification of the function increases computational efficiency.

$$\ln L = \sum_{t=1}^{N} \sum_{j=1}^{2} Y_{tj} * \ln P_{tj}.$$

$$\ln L = \sum_{t=1}^{N} \left[Y_{tR} \ln \left(\frac{e^{\theta' W_{tr}}}{1 + e^{\theta' W_{tr}} + e^{\theta' W_{tE}}} \right) + Y_{tL} \ln \left(\frac{1}{1 + e^{\theta' W_{tr}} + e^{\theta' W_{tE}}} \right) \right].$$

$$= \sum_{t=1}^{N} \left\{ Y_{tR} \left[\theta' W_{tR} - \ln \left(1 + e^{\theta' W_{tR}} + e^{\theta' W_{tE}} \right) \right] + Y_{tL} \left[0 - \ln \left(1 + e^{\theta' W_{tR}} + e^{\theta' W_{tE}} \right) \right] \right\}$$

$$\ln L = \sum \left[Y_{tR} * \theta' W_{tR} - \left(Y_{tR} + Y_{tL} \right) \ln \left(1 + e^{\theta' W_{tR}} \right) \right]$$

Since $Y_{tR} + Y_{tL} = 1$,

$$\ln L = \sum_{t=1}^{N} \left[Y_{tR} * \theta' W_{tR} - \ln \left(1 + e^{\theta' W_{tR}} \right) \right]$$

APPENDIX D: SRB MODEL'S PREDICTED AND ACTUAL FY2002 REENLISTMENT RATES

Occupation	MOS	Predicted	Actual
00B DIVER	00B	40%	24%
02D FRENCH HORN PLAYER	02D	18%	41%
02H OBOE PLAYER	02H	0%	0%
02J CLARINET PLAYER		24%	16%
02N KEYBOARD PLAYER	02N	0%	11%
11B INFANTRYMAN	11B	26%	16%
11B W/"G,V"	11B	30%	25%
11B W/"P"	11B	0%	16%
11C IND FIRE INFMAN	11C	18%	13%
11H HVY AA WPNS INF	11H	0%	33%
11M FV INFANTRYMAN	11M	0%	23%
12B W/"P"	12B	19%	14%
13B CANNON CRWMEM	13B	23%	19%
13B W/"P"	13B	31%	19%
13E CANNON FD SP	13E	29%	23%
13E W/"P"	13E	28%	14%
13F FIRE SUP SP	13F	23%	14%
13F W/"P"	13F	19%	16%
13F W/"V"	13F	7%	0%
13M MLRS CRWMEM	13M	24%	19%
13P MLRS/FIRE DIR SP	13P	27%	23%
13R FA FF RDR OP	13R	36%	29%
13R W/"P"	13R	35%	29%
14E PATRIOT OP/MNT	14E	28%	25%
14J AD C4I TAC OPNS C	14J	18%	17%
14R BRADLEY LNBKR CRW	14R	30%	26%
14S AVENGER CRWMEM	14S	13%	10%
14T PATRIOT LS ENH OP	14T	28%	23%
18B SF WEAPONS SERGE	18B	40%	38%
18C SF ENGINEER SERGE	18C	40%	34%
18D SF MED SERGEANT	18D	48%	37%
18E SF COMMO SERGEANT	18E	48%	30%
18F SF ASST OP/INTEL	18F	50%	75%
19D CAVALRY SCOUT	19D	28%	18%
25M W/"P"	25M	7%	11%
25R W/"P"	25R	0%	17%
27E LC ELEC MSL SYS R	27E	19%	16%
27M MLRS REP	27M	15%	3%
27T AVENGER SYS REP	27T	25%	13%
27T W/"P"	27T	11%	0%
31C RADIO OP/MAINT	31C	16%	11%
31C W/"P,V,S"	31C	27%	21%
31F NETWORK SW SYS OP	31F	14%	16%
31F W/"P"	31F	21%	18%
31L CABLE SYS INST/MA	31L	15%	13%
31L W/"P"	31L	15%	14%
31P MICROWAVE SYS OP/	31P	18%	16%
31P W/"P"	31P	31%	19%
31R MCHAN XMSN SYS OP	31R	21%	20%
31S SAT COM SYS OP/MN	31S	17%	21%

Occupation	MOS	Predicted	Actual
31S W/"P"	31S	22%	20%
31U W/"P"	31U	0%	7%
33W EW/INT SYS REP	33W	22%	17%
35D ATC EQUIP REP	35D	4%	14%
35E RADIO/COMSEC REP	35E	22%	17%
35E W/"P"	35E	27%	24%
35F W/"P"	35F	45%	8%
35H W/"P"	35H	0%	0%
35J COMP/AUTO SYS REP	35J	14%	12%
35J W/"P"	35J	36%	7%
35L W/"P"	35L	0%	17%
35M RADAR REP	35M	27%	20%
35N W/"P"	35N	0%	0%
35R AVIONICS RADAR RE	35R	6%	12%
35R W/"P"	35R	0%	14%
35Y IFTE OP/MNT	35Y	17%	17%
35Y W/"P"	35Y	0%	14%
37F PSYOP SP	37F	23%	16%
39B ATE OP/MAINT	39B	0%	16%
44B W/"P"	44B	0%	0%
44E W/"P"	44E	0%	0%
45B W/"P"	45B	31%	39%
45D SP FA TURRET MECH	45D	10%	8%
45E M1 TANK TURRET ME	45E	12%	4%
45G FIRE CONTROL REP	45G	7%	11%
45T BFVS TURRET MECH	45T	27%	10%
46Q JOURNALIST	46Q	15%	6%
46Q W/"P"	46Q	0%	20%
46R BROADCAST JOURNAL	46R	10%	9%
46R W/"P"	46R	0%	0%
51B W/"P"	51B	31%	3%
51K W/"P"	51K	0%	0%
51R W/"P"	51R	0%	0%
51T W/"P"	51T	0%	33%
52C UTIL EQUIP REP	52C	28%	5%
52C W/"P"	52C	11%	18%
52D POWER GEN EQUIP R	52D	0%	3%
52D W/"P"	52D	27%	10%
52E PRIME POWER PROD	52E	16%	23%
54B CHEM OPNS SP	54B	31%	19%
54B W/"P"	54B	34%	22%
55B AMMUNITION SP	55B	0%	8%
55D EOD SP	55D	20%	27%
62B CONST EQUIP REP	62B	0%	5%
62B W/"P"	62B	30%	7%
62E W/"P"	62E	18%	7%
62F W/"P"	62F	60%	0%
62H CONCRETE/ASPHALT	62H	0%	8%
62J GENERAL CONST EQU	62J	0%	%
62J W/"P"	62J	13%	%
63D SELF-PROP FA SYS	63D	17%	13%
63E M1 TANK SYS MECH	63E	15%	7%
63G FUEL/ELECT SYS RE	63G	17%	7%
63G W/"P"	63G	0%	0%
63H TRACK VEHICLE REP	63H	13%	10%

Occupation	MOS	Predicted	Actual
63J W/"P"	63J	24%	0%
63S HV WHEEL VEHICLE	63S	0%	7%
63T BRADLEY FV SYS ME	63T	20%	15%
63Y TRACK VEHICLE MEC	63Y	27%	13%
67R AH-64 ATTACK REP	67R	38%	27%
67R W/"Y1"	67R	29%	26%
67S OH-58D REP	67S	0%	8%
67S W/"P"	67S	36%	12%
67T UH-60 REP	67T	30%	17%
67U CH-47 REP	67U	31%	28%
68B AIRCFT PWRPLNT RE	68B	29%	22%
68B W/"P"	68B	12%	15%
68D AIRCFT PWRTRN REP	68D	9%	27%
68D W/"N2"	68D	38%	22%
68D W/"P"	68D	33%	11%
68F AIRCFT ELECTRICIA	68F	0%	4%
68F W/"P"	68F	36%	9%
68G AIRCFT STRUCTURAL	68G	28%	16%
68G W/"P"	68G	18%	0%
68H AIRCFT PNEUDRAULI	68H	25%	17%
68H W/"P"	68H	0%	67%
68N W/"P"	68N	38%	0%
68X AH-64 ARM/ELEC SY	68X	16%	20%
68Y AH-64D AR/EL/AV S	68Y	13%	23%
71D W/"P"	71D	44%	0%
71L W/"P"	71L	24%	13%
73D W/"P"	73D	0%	22%
74B INFO SYS OP-ANALY	74B	20%	26%
74B W/"P"	74B	18%	14%
74C INFO OP-MAINT	74C	0%	3%
74C W/"P,V,S"	74C	23%	4%
74G TELE COMPUTER OP-	74G	0%	2%
75B W/"P"	75B	20%	15%
75F W/"P"	75F	0%	0%
77F PETRO SUP SP	77F	25%	21%
77L PETRO LAB SP	77L	0%	4%
79R RECRUITER	79R	77%	60%
81T TOPO ANALYST	81T	17%	19%
82C FA SURVEYOR	82C	20%	13%
82C W/"P"	82C	19%	19%
88L WATERCRAFT ENGINE	88L	35%	21%
88N W/"P"	88N	7%	0%
91C PRACTICAL NURSE	91C	0%	14%
91D OPERATING ROOM SP	91D	24%	16%
91E W/"N5"	91E	29%	14%
91E W/"X2"	91E	30%	14%
91K MED LAB SP	91K	21%	17%
91K W/"M4"	91K	29%	14%
91K W/"P9"	91K	14%	24%
91M HOSP FOOD SERVICE	91M	15%	7%
91P RADIOLOGY SP	91P	3%	8%
91P W/"M5"	91P	0%	11%
91Q PHARMACY SP	91Q	0%	5%
91S W/"N4"	91S	0%	8%
91T ANIMAL CARE SP	91T	13%	5%

Occupation	MOS	Predicted	Actual
91V RESPIRATORY SP	91V	11%	23%
91X MENTAL HEALTH SP	91X	33%	15%
92A W/"P"	92A	0%	6%
92G FOOD SERVICE SP	92G	23%	26%
92G W/"P"	92G	30%	33%
92R PARACHUTE RIGGER	92R	35%	28%
92Y W/"P"	92Y	27%	20%
93C ATC OP	93C	24%	18%
93F FA MET CRWMEM	93F	0%	0%
93F W/"P"	93F	0%	50%
93P AVIATION OPNS SP	93P	0%	6%
93P W/"P"	93P	33%	16%
95B MILITARY POLICE	95B	18%	19%
95B W/"P"	95B	5%	14%
95C CORRECTIONS SP	95C	30%	18%
95D CID SPECIAL AGENT	95D	3%	14%
96B INTELL ANALYST	96B	21%	20%
96B W/"P"	96B	27%	24%
96D IMAGERY ANALYST	96D	23%	19%
96D W/"P"	96D	29%	24%
96H CGS OP	96H	21%	22%
96R GRD SURV SYS OP	96R	17%	23%
96U UNMANNED AERIAL V	96U	35%	20%
97B COUNTER INTELL AG	97B	22%	12%
97B W/"P"	97B	27%	18%
97E AD	97E	16%	15%
97E FR	97E	0%	0%
97E KP	97E	9%	21%
97E PF	97E	20%	20%
97E RU	97E	21%	17%
97E W/"P"	97E	5%	4%
97E W/"P,V,S" & AD	97E	22%	33%
97E W/"P,V,S" & FR	97E	0%	0%
98C SIGNALS INTELL AN	98C	27%	20%
98G AD	98G	16%	17%
98G CM	98G	10%	23%
98G FR	98G	0%	0%
98G KP	98G	10%	31%
98G PF	98G	29%	11%
98G RU	98G	0%	6%
98G SC	98G	0%	7%
98G W/"P,V,S" & AD	98G	20%	20%
98G W/"P,V,S" & FR	98G	0%	0%
98H COMMO INTCEPT/LOC	98H	21%	22%
98H W/"P,V,S"	98H	0%	18%
98J EL INTELL INT/ANL	98J	26%	20%
98J W/"P"	98J	25%	13%
98K SIG ID ANALYST	98K	22%	22%